

# **Sandia and the Waste Isolation Pilot Plant 1974 - 1999**

*Being an Accurate and Truthful Historical Account  
of Sandia National Laboratories' Contribution in  
Resolving the Technical Issues in a Dynamic  
Political and Societal Framework*


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**Sandia National Laboratories**

A Department of Energy National Laboratory





This study was performed at Sandia National Laboratories. Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy under Contract DE-AC04-94AL85000.

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SAND99-1482

Sandia National Laboratories  
Albuquerque, New Mexico 87185  
Livermore, California 94551  
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FG2929.CA324.jg/8/99

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Albuquerque, New Mexico

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# PREFACE

In 1975, the newly organized Energy Research and Development Agency asked Sandia National Laboratories (at the time, just Sandia Laboratories) to be the principal scientific investigator for a proposed repository in southeastern New Mexico for the disposal of radioactive transuranic defense waste generated by nuclear weapons production. This repository would shortly be designated the Waste Isolation Pilot Plant (WIPP), Sandia's longest-lasting, most visible, and one of its most controversial projects. The Sandians who were originally assigned to the project anticipated that their involvement would last no longer than six years. But politics, bureaucratic procedures, and challenges in the courts protracted the life of the project to twenty-five years. Originally slated for completion in 1983, WIPP was finally completed in 1990. New and more complex regulatory requirements, politics, and legal proceedings kept delaying the shipment of radioactive waste to WIPP. On October 22, 1997, the U.S. Environmental Protection Agency issued a decision declaring that the world's first permanent nuclear waste repository was safe to open. But it was not until March 22, 1999, that the U.S. District Court in Washington, D.C. cleared the way for transuranic waste to be shipped to WIPP. On March 26, the first truckload of waste containers was transported from Los Alamos National Laboratory and delivered to WIPP.

The purpose of this historical narrative is to relate the story of Sandia's twenty-five-year-long participation in the WIPP project, especially through the memories and words of some of the Sandians who participated in the early days of the project. It was they who carried out the first detailed geological studies in the Los Medanos area, an arid plateau near the Pecos River about twenty-five miles east of Carlsbad, New Mexico. And it was they who, through innovative scientific investigations, found that the original site was geologically unsuitable and chose the present location. These accomplishments required many long hours of travel, work in the field—an arid and desolate field at that—and long absences from home and family.

The extensive scientific investigations carried out by Sandians have resulted in a mountain of published reports and studies, all available to the public and academic researchers. This narrative does not attempt to review the purely technical aspects of WIPP but instead focuses on the people involved and how they responded to the challenges—technical, political, and personal—of this complex enterprise.

The writing of this history would have been impossible without the generous cooperation of many people and their willingness to take time from their busy schedules to talk with me and respond to questions. First of course is Wendell

Weart, “The Sultan of Salt,” Sandia’s technical director and inspiration throughout the often stressful twenty-five years duration of the WIPP project. Wendell was unstinting with his time, making himself available for many interviews, recommending other people for me to talk with, providing documents, and reviewing and offering comments on various drafts.

Others who provided valuable information in a series of videotaped panel discussions and audiotaped interviews were Felton Bingham, Pat Brannen, Lokesh Chaturvedi, Chris Christensen, Peter Davies, George Griswold, Les Hill, Tom Hunter, Steve Lambert, Al Lappin, Joseph Magruder, Jim McIlmoyle, Jerry Mercer, Mel Merritt, John Milloy, Martin Molecke, Bob Neill, Sieglinde Neuhauser, James Nowak, Susan Pickering, Dennis Powers, Rob Rechard, Thomas Schultheis, Leo Scully, Pete Seward, Bill Snyder, Bob Statler, Bob Stinebaugh, Joe Tillerson, Lynn Tyler, and Richard Yoshimura.

I am grateful to the following persons for reading various drafts of the manuscript and offering information and comments: George Barr, Jim Bickel, Dan Garber, Critz George, Robert Guzowski, Richard Lincoln, Myra O’Canna, Andrew Peterson, Kate Trauth, Rebecca Ullrich, and Don Vieth. Special thanks to Ferne Allan and Sandy Halliday of Sandia’s Nuclear Waste Management Program Library for providing reports, references, and articles on short notice. Anna Nusbaum, my manager, not only read the draft but has constantly provided enthusiastic support for this WIPP history and other projects in the Sandia Corporate History Program. And special kudos to Jan Gaunce for beautifully designing this book. John Trever kindly gave permission to use three of his editorial cartoons originally published in the *Albuquerque Journal*.

Although all of the above Sandians and non-Sandians, active and retired, offered invaluable insights and information, any errors in this publication are entirely my responsibility.

Carl J. Mora  
Corporate Historian  
Sandia National Laboratories



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# FOREWORD

I could never have surmised in 1974, when I first became associated with the WIPP, that it would occupy 25 years of my professional career. From 1975, when Sandia was assigned responsibility for direction of the WIPP scientific studies, until 1995, I managed Sandia's WIPP project activities. Since then I have been closely involved with WIPP as scientific advisor in my capacity as Senior Scientist and Sandia Fellow. These 25 years have been enormously rewarding, not only for the opportunity to address challenging scientific issues but also because the WIPP project addressed a problem of great national significance and offered an opportunity to guide a major program from its inception to its completion. WIPP has developed to be the project of longest duration ever undertaken at Sandia. The continuity and historic knowledge that Sandia provides to the WIPP have proven to be a valuable asset to the project. This report, in fact, provides a valuable historic context within which to examine and guide the project.

Sandia was fortunate, in those early years, to be trusted by the DOE to develop the scientific program with a minimum of oversight and interference. We had a team of key technical players, such as the United States Geological Survey (USGS), INTERA (a firm specializing in hydrologic services—both field work and modeling), Fenix and Scisson, Bechtel, and others too numerous to mention. We were able to make enormous progress in short periods of time because we operated as a team with a common goal and without interagency competition. While there were often heated technical discussions among participants, it was understood and agreed by all that when all the factors had been considered, the final technical decision was Sandia's call. The activities in the first 10 to 15 years were intense, but we all enjoyed the work and camaraderie. In later years this team spirit did not come as naturally, and we consciously had to work at maintaining it. DOE's attitude toward Sandia began to shift to consideration of the lab as "just another contractor" rather than as an equal and trusted team member. And other WIPP participants, who were added as the project grew, began to question Sandia motives and decisions and agitate for a share of our responsibility. Despite these policy concerns, because the scientific problems were interesting and challenging, outstanding Sandians were attracted to work toward their resolution.

We were, in retrospect, a small, somewhat naïve group of Sandians that first began work on the WIPP Project in 1975. We believed that our role might be over in a half dozen years. What we initially perceived as relatively simple issues, proved upon subsequent study to be more and more complex, requiring more detailed examination to ensure that WIPP could be shown to be safe over a very long period of time. Indeed one is perhaps most certain and confident

that the relevant repository issues are adequately understood just prior to beginning the detailed investigations.

For the first 10 years of the WIPP studies we developed our own criteria to guide site and repository acceptability since no formal regulatory standards existed. We chose to be conservative (relative to the standards that finally evolved) which stood us in good stead as unfolding regulatory demands put more and more of a burden on quantitative demonstration of compliance. Experience has shown there is no substitute for a robust site.

As the studies progressed and layer upon layer of understanding unfolded, the question became more one of when and how does one determine that sufficient knowledge exists to satisfy the requirements of repository safety. Sandia developed the Performance Assessment technique that was to provide the answer to this question of knowledge adequacy. It was formally applied through the System Performance Methodology (SPM) study. This study told us how much, and which, scientific data were sufficient to establish compliance with the EPA regulations. The merit of the SPM and Performance Assessment technique was borne out by EPA's certification of the WIPP as a safe repository fully meeting its regulations.

Sandia and the WIPP Project did not make technical decisions without the extensive oversight and advice of external peer review. Since 1978 the National Academy of Sciences and the State of New Mexico Environmental Evaluation Group have provided valuable and often critical comment on the content and direction of the scientific program. I believe the WIPP stands on a much firmer scientific foundation and is viewed with more confidence by the public and external scientists because of their participation.

I would be remiss if I did not mention that the assurance and confidence required by the external regulatory and peer reviewers could not have been obtained without the significant contributions of our Quality Assurance program. This program applied a degree of assurance detail not commonly expected for a research effort. The scientific rigor of our technical studies, many of which were conducted before the current generation of QA procedures were in effect, have withstood the intense scrutiny of our own internal and EPA's external reviews.

The 25-year trip on the road to WIPP compliance and operation has not been without many potholes and detours along the way. Much time and effort have gone into addressing, in a quantitative and definitive way, issues which sound professional judgment would have said were without merit. But in the very contentious, emotional, and litigious environments that accompany

radioactive issues, and especially geologic repositories, professional judgments are not accepted and it has been necessary to “go the extra mile” in providing “proof.”

Many times the detours have resulted from policy changes as new administrations believe they have a better insight on how to solve the thorny radioactive waste disposal problem. In most cases, however, these changes in direction have only prolonged the process and raised questions in the public’s mind as to whether there really was a solution to radwaste disposal.

Now, with WIPP having surmounted the multitudinous hurdles—technical, political and legal—imposed along its path, we can say that the problem is capable of solution. WIPP provides a positive signal to the world that radioactive waste disposal is not too difficult a problem to overcome.

Wendell D. Weart



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# A BRIEF HISTORICAL PRELUDE TO WIPP

The problem of how to dispose of radioactive wastes first arose during World War II in the Manhattan Project. Because the Project's single urgent purpose was to develop and produce a fission weapon, waste management concerns were given short shrift. J. Robert Oppenheimer, the legendary director of Los Alamos Laboratory, considered waste management to be "unimportant"<sup>1</sup> and this attitude was pervasive throughout the Manhattan Engineer District. According to a report written in 1948, "Los Alamos simply dumped radioactive and toxic materials into adjacent canyons, a procedure that could not be continued for very long in the future."<sup>2</sup> This even though Los Alamos was required to adhere to guidelines established by the newly formed Atomic Energy Commission (AEC): To store high-level waste as liquids in tanks and to bury other waste in trenches until such time that a more permanent method of disposal could be devised.<sup>3</sup> It soon became evident these temporary measures were unsatisfactory and that the search for a more permanent solution should begin in earnest.

In the mid 1950s, the AEC asked the National Academy of Sciences (NAS) to study the problem and make suggestions for the permanent disposal of high-level waste. The NAS Committee on Waste Management issued a report in 1957 which stated, "The most promising method of disposal of high-level waste at the present time seems to be in salt deposits."<sup>4</sup> In 1960 the NAS's National Research Council (NAS-NRC) reported to the AEC that "no existing AEC site generating high- or intermediate-level wastes possessed suitable geological conditions for the safe disposal of...wastes."<sup>5</sup> The NAS-NRC urgently recommended that the AEC establish waste-disposal facilities at "separate and suitable geological sites."<sup>6</sup>

However, the general public's mood of complacent confidence in government institutions typical of the postwar Eisenhower era of the 1950s still prevailed. As David Halberstam wrote, "In that era of general good will and expanding affluence, few Americans doubted the essential goodness of their society."<sup>7</sup> This attitude generally extended to the issue of radioactive wastes generated by the AEC's installations, and was helped along by that agency's successful efforts to keep the problem out of the public limelight.

The AEC's Reactor Development Division, which had commissioned a 1965 NAS-NRC report, was uncomfortable with its critical tone of AEC waste management practices and delayed issuing it.<sup>8</sup> It was not until May 1966 that

the report was formally submitted to AEC waste management officials, who rejected the NAS-NRC's overall criticism but accepted some of the specific recommendations for disposing of transuranic (TRU) wastes, which are byproducts of the production of nuclear weapons. Among these recommendations was a reiteration of the proposal made in 1957 by the NAS-NRC of using salt deposits for the permanent storage of high-level radioactive waste. The NAS-NRC report had pointed out that vast deposits of salt are found in stable geological areas with little seismic activity. The very existence of the salt beds demonstrates the absence of circulating ground water (because if mobile water had been present, it could have dissolved the salt beds). In addition, salt is relatively easy to mine and it has the ability to heal fractures because of its plastic quality, i.e., salt will move in or "creep" to fill a void or to seal a waste repository.

Although the fledgling environmental movement had not yet discovered the potential hazards of nuclear waste, the U.S. Congress was becoming more watchful of the AEC. For instance, in 1968 the Joint Committee on Atomic Energy asked the General Accounting Office (GAO) to review the AEC's high-level waste activities. The GAO report was critical of the AEC's handling of waste management and asserted the need for independent evaluation of its policies and practices.<sup>9</sup>

"The event that shattered the AEC's complacency and irrevocably made defense nuclear wastes a public issue" was the Rocky Flats fire of May 11, 1969, which caused \$45 million in damages.<sup>10</sup> Subsequent investigations revealed contamination from a 1957 fire, knowledge of which had been kept from the public. This "stirred local environmentalists and scientists" to press the AEC for additional information.<sup>11</sup> Then the *New York Times* reported that 330,000 cubic feet of plutonium-contaminated waste involved in the Rocky Flats blaze was planned to be buried in Idaho.<sup>12</sup> After complaints that the state was becoming a "dumping ground" for atomic waste, the issue was picked up by Idaho public officials and the local press, especially after it was learned that burial of transuranic waste from Rocky Flats had been going on at Idaho National Engineering Laboratory for years. Senator Frank Church of Idaho asked four federal agencies—the Bureau of Sport Fisheries and Wildlife, the US Geological Survey, the US Public Health Service, and the Federal Water Quality Administration—to study the long-range implications of waste burial on the underlying aquifer. By early 1970, the four agencies were reporting their findings to Senator Church. Their reports openly criticized the AEC's waste management practices at Idaho National Engineering Laboratory.<sup>13</sup>

Under pressure from Senator Church, the AEC decided to terminate long-term storage at Idaho in favor of placing transuranic wastes in a salt mine at Lyons, Kansas.<sup>14</sup> On the basis of the NAS's 1957 recommendations for radioactive



disposal in salt formations and its reaffirmation of this position in 1966, the AEC initiated several years of research, directed by Oak Ridge National Laboratory (ORNL), on the phenomena associated with disposal of radioactive waste in salt. AEC Chairman Glenn T. Seaborg informed Senator Church that when the salt mine at Lyons, Kansas became fully operative as a repository, it was planned to not only dispose of currently generated wastes at the site but also to transport transuranic wastes stored in Idaho. Also, in 1970, AEC Chairman Dixy Lee Ray told Senator Church that the waste stored in Idaho would be removed by 1980 and sent to Lyons.<sup>15</sup>

Transuranic, or TRU, waste is a third category of radioactive waste defined in 1970 and distinct from high- and low-level waste. It also has potential for emitting significant levels of radioactivity. It consists of TRU-waste-contaminated soil, clothing, machine parts, and other residue from the U.S. bomb-making program contaminated with radionuclides heavier than uranium with half-lives greater than 20 years and a level of contamination exceeding 100 nanocuries per gram (for a time the level was 10 nanocuries).<sup>16</sup> TRU waste's hazards are comparable to those of low-level waste, except that many TRU elements have long half-lives: for instance, the half-life of plutonium 239, the principal transuranic waste isotope, is 24,360 years. This long half life requires geologic repository disposal rather than shallow land burial used for low-level waste. The TRU waste generated since 1970 has been stored in steel drums or waste boxes awaiting the day when a permanent salt repository is constructed.<sup>17</sup>

The blurring of the distinction between civilian and defense wastes has its origin in these early debates about the safe disposal of low-level and high-level nuclear waste. Defense wastes, both high-level and low-level, were the principal problem in the 1960s because of the intense buildup of the nation's nuclear stockpile since the 1950s. High-level "civilian" or "commercial" wastes were nonexistent before Congress passed the Atomic Energy Act of 1954 that allowed the federal government and private industry to become partners in the promotion of commercial nuclear power.

The first full-scale nuclear-powered generating station was the Shippingport Atomic Power Station on the Ohio River at Shippingport, Pennsylvania, which was opened in 1957. Built by the AEC, this nuclear plant was developed to transfer nuclear technology to civilian hands, because it was not anticipated that private industry would invest sufficiently in the long-term research needed to achieve civilian nuclear power. By 1962, fifty-three power reactors were either being designed, under construction, or operating in the United States. In 1999, there were 110 units, or power generating plants, on seventy-three operating reactor sites.

The first operating commercial reprocessing facility opened at West Valley, New York in 1966, which generated liquid high-level wastes. It was shut down in 1972 because it could not meet the new AEC regulations of November 1970 requiring solidification of wastes in a suitable form for disposal in a federal repository. Closed for modifications, West Valley never reopened.<sup>18</sup> The AEC was now under increased pressure to dispose of high-level wastes in the underground salt mines in Lyons, Kansas, because it was the only site being considered, even though AEC Chairman Seaborg had described it to Senator Church as a repository exclusively for transuranic wastes.<sup>19</sup>

By 1970, the AEC felt that it had a workable program for what it regarded as the most significant waste management issue: the disposal of civilian and military high-level wastes. It decided, first, that spent fuel from civilian nuclear power reactors would be reprocessed, with the waste solidified and shipped to a federal repository. Second, the AEC would build a repository for permanent, irretrievable storage (i.e., disposal) of the solidified waste in a bedded salt formation, with the Lyons site serving as a demonstration facility. And third, civilian and military high-level wastes would be stored in canisters on-site at the Richland site in Hanford, Washington, the Savannah River Site in South Carolina, and Idaho National Engineering Laboratory.

ORNL conducted Project Salt Vault in an existing salt mine at Lyons, Kansas between 1963 and 1967.<sup>20</sup> Some irradiated fuel elements supplemented with electric heaters were emplaced in the mine, and many thermal and salt deformation measurements were taken. The results from these experiments were favorable, with no unacceptable phenomena being identified that would rule out bedded salt at this location as a repository medium. In June 1970, the AEC tentatively selected the Lyons site as the location for a radioactive waste repository. The concept and the location were conditionally endorsed by the NAS committee in November 1970.<sup>21</sup>

A conceptual design for a facility accommodating both transuranic and high-level waste (HLW) was completed in 1971. However, two basic technical problems in the siting were raised that same year. First, the presence of a large number of existing oil and gas boreholes was detected in the vicinity of the potential repository. These boreholes penetrated through the salt beds into underlying aquifers, raising the concern that not all of these boreholes could be adequately plugged if identified, and not all such boreholes were on record and identified. Consequently, ground-water flow through boreholes resulting in the dissolution of the surrounding salt and eventual breaching of the repository could not be ruled out.

The other concern related to the solution mining that the American Salt Mining Company was carrying out about three miles from the proposed

repository. Solution mining is the name given to the process of injecting fresh (or relatively fresh) water down a borehole that has been drilled into salt or a potash-rich zone in salt. The water dissolves the salt/potash and the resulting “brine” is withdrawn, usually up through another borehole. Mining this way, when conditions are favorable, is relatively cheap and easy when compared with conventional mining with shafts and drifts (tunnels).<sup>22</sup> During hearings it came to light that large volumes of water were unaccountably “lost” presumably because they flowed into pre-existing openings or hydraulic fractures. Solution mining was regarded as foreshadowing a process ultimately threatening to the proposed site.<sup>23</sup>

Kansas state officials and environmentalists now joined forces in opposing the project declaring that “the will of the people of Kansas”<sup>24</sup> and not mere technical feasibility should determine whether the Lyons facility should be built. Interestingly, this argument anticipated the later controversy in New Mexico whether the state should have veto power over federal projects, specifically the proposed Waste Isolation Pilot Plant (WIPP). Project Salt Vault “became such a furor in the State of Kansas”<sup>25</sup> that the AEC abandoned the effort to site a repository there, both because of the technical concerns impinging on the suitability of the site and the public and political outcry.

In 1972, the AEC’s high-level waste policy began to come apart—first with the closing of the West Valley reprocessing plant and then with the demise of the Lyons, Kansas project. Plans for the disposal of high-level waste by fluid injection into the underlying bedrock at the Savannah River Site in South Carolina were criticized by Governor Jimmy Carter of Georgia and Senator Ernest F. Hollings of South Carolina. Plans to solidify wastes directly in storage tanks at Hanford Site in Washington were cast into doubt and aborted because of the discovery of a leaking tank. In late 1999, these tanks, their contents, and the radioactive fluid that has leaked from some tanks is still a major focus of DOE’s Environmental Restoration Program.

ORNL and the US Geologic Survey (USGS) proceeded to look for suitable salt beds in other parts of the Permian Basin (which encompasses Texas, New Mexico, Nebraska, and Kansas) for a potential repository. By 1973, they had concluded that the general area of east-central and southeastern New Mexico held the best promise for containing bedded salt deposits with desirable characteristics for a projected radioactive waste repository.

Even before the area was identified as apparently geologically desirable, it received more interest because of state and local expressions of interest. When Carlsbad city officials learned that Lyons, Kansas would not be a waste repository, they approached the AEC asking it to consider the exhausted potash mines east of the city as a nuclear waste repository site. After considering four

potential sites in eastern and southeastern New Mexico,<sup>26</sup> the AEC in 1973 asked the Army Corps of Engineers to prepare a report on a “prime study area”<sup>27</sup> called Los Medanos,<sup>28</sup> located on the Eddy-Lea county line in southeastern New Mexico about 30 miles east of Carlsbad in an area whose principal industries were cattle ranching and potash mining. In its report, the Corps of Engineers described the Los Medanos area as “a gently rolling topography with some sand hummocks and moderate gullies. The soils are reddish loamy fine sand, sandy clay loam, fine sand, and caliche [gravel, sand, or desert debris cemented by calcium carbonate]. The vegetative cover includes mesquite, creosote, native cacti, sand grasses, russian thistle and other weeds.”<sup>29</sup>

Los Medanos is in the north-central part of the Delaware Basin, an 8,920-square-mile region extending from southeastern New Mexico to western Texas where evaporation in a shallow sea deposited over 3600 feet of evaporites during the Permian period between 286 and 245 million years ago.<sup>30</sup> Capitan Reef, “...similar to the Great Barrier Reef of Australia with its giant horseshoe shape,”<sup>31</sup> defines the northern boundary of the Delaware Basin. According to a field trip guide to the area, “Several geologists have observed that one spends a lot of travel time between localities in the Delaware Basin, and that both topography and geology are subtle.”<sup>32</sup> The AEC proposed that a repository at this site be built in the nearly pure salt of the Salado Formation, which is nearly a half-mile thick and occurs at acceptable depths between 1500 and 3000 feet.

The main natural resources in the region are potash minerals and hydrocarbons (oil and gas). Potash deposits occur regionally in a zone varying from 800 to 1900 feet below the surface (about 1500 feet at the WIPP site), and oil and gas occur in various strata from 7000 to 14,000 feet below the surface. This area east of Carlsbad is the principal US source of the potash minerals, sylvite and langbeinite, which are processed in the production of fertilizers.<sup>33</sup>

In 1974, ORNL and USGS scientists drilled two exploratory wells in the Los Medanos area and extracted some core samples as part of their initial underground exploration of the preferred site. The two wells, designated AEC-7 (3918 feet deep) and AEC-8 (3028 feet deep), were drilled at the northeast and southwest corners, respectively, of a 1-1/2-by-2-square-mile rectangular area (which does not correspond to the final WIPP site). ORNL decided that the data obtained from these holes supported repository requirements, but work at the site was suspended in May 1974 for several reasons, not the least of which was an impending major reorganization of the federal nuclear energy program.

The AEC at this time also shifted its attention to plans for retrievable surface storage facilities (RSSF) for nuclear waste. As an interim solution for getting the



civilian high-level waste program back on track, the AEC proposed to design and build surface storage facilities at Hanford for solidified high-level commercial wastes. The facilities were to be available by the end of the decade when the first quantities of civilian waste would be ready for delivery. The Hanford facilities were designed to contain all commercial wastes generated during the remainder of the century. The transuranic defense wastes that had been slated for the Lyons repository would be stored in separate, specially designed facilities. At the same time, the AEC decided to reorient research and development on bedded salt repositories toward construction of a pilot plant. Wastes to be disposed of in the underground pilot plant, possibly including transuranic wastes, would be stored in barrels or canisters on pads where they could be kept under surveillance and control, and thus easily retrievable. The search for the pilot plant site was now concentrating on the worked-out potash mines in New Mexico.<sup>34</sup>

Also in 1974, AEC Chairman Dixy Lee Ray refused to set aside the Los Medanos area (and its protective “buffer” zones) for the proposed repository.<sup>35</sup> By law<sup>36</sup> repositories have to be situated on federal land, so before work could proceed on the site, a portion of the land would have to be transferred to the Bureau of Land Management (BLM) which would then transfer it to AEC control. This would have meant closing the area to oil exploration in the face of the oil embargo imposed by the Organization of Petroleum Exporting Countries on the heels of the 1973 Yom Kippur War between Israel and Egypt, Syria, and Jordan. Because the oil embargo resulted in widespread fuel shortages and long lines of frustrated motorists at gas stations throughout the country, barring any oil exploration would have been politically controversial.

But more significant events loomed. Federal energy policy, programs, and reorganization plans languished during the Watergate Crisis until August 1974, when Richard Nixon resigned and Vice-President Gerald R. Ford stepped into the presidency. Ford moved with alacrity to reestablish White House direction over federal energy activities. On October 11, 1974, he signed the Energy Reorganization Act into law thereby abolishing the AEC and, in its place, establishing in January 1975 the Energy Research and Development Administration (ERDA) and the Nuclear Regulatory Commission (NRC). The latter inherited the licensing and regulatory functions for high-level waste repositories of the erstwhile AEC. ERDA’s main overall functions were weapon development, energy policy development, and energy technology development.

The staff of the newly activated ERDA consisted for the most part of the same AEC officials. But in the new agency, shorn of past attitudes and policies, these officials now felt freer to envisage new solutions. According to two DOE historians:

The new agency, nonetheless, brought the potential for change and new direction. Under continual public attack, the AEC staff had tended to become sensitive to criticism and thus less than imaginative and creative in formulating plans. As ERDA staff, however, the same officials could now disavow the errors and commitments of the past and take a fresh and unbiased look at waste disposal practices and problems.<sup>37</sup>

Two weeks after the agency's creation, ERDA officials moved quickly to examine all aspects of the nuclear-fuel cycle. A special task force reported that the waste end of the cycle was "at a standstill."<sup>38</sup> With West Valley closed down, there was no commercial facility to reprocess spent fuel from civilian power reactors. Also, no technology had been demonstrated for retrievable surface storage, and permanent geologic disposal had still not been demonstrated. The task force also noted the critical need to agree on a means for the ultimate disposal of defense wastes. Throughout these high-level reorganizations and policy shifts, the ORNL field testing at Los Medanos had perforce remained in limbo.

For both the civilian and defense programs, early demonstration of permanent disposal technology was essential. It should be kept in mind that to this end a number of alternative disposal possibilities were being examined in the 1970s, among them "...storing waste in the ice sheets in Antarctica or rocketing the material into outer space."<sup>39</sup> Although neither of these two options was promising, another potential solution, to bury wastes in sediments beneath the ocean floor, attracted wide international attention and support.

The Subseabed Disposal Project (SDP), under Sandia's direction, began in the late 1960s as "an oceanographer's pipe dream" and grew after 1973 into an "international, multidisciplinary programme which [presented] a serious alternative to the land-based national HLW disposal concepts."<sup>40</sup> The basic concept was that containers of high-level radioactive wastes would be placed within geologically stable and biologically inactive deep-ocean sediments built up during millions of years and which are becoming sedimentary rocks. Sandia's SDP was managed by D. Richard "Rip" Anderson until it was terminated by Congress in 1988.

In 1970, Governor David Cargo of New Mexico (1967-1971) formed the Governor's Technical Excellence Committee (GTEC) as a study group to liaise with the state's defense installations such as Sandia, Los Alamos, Kirtland AFB, and Cannon AFB "to try to tie them into private industry."<sup>41</sup> The existing GTEC thus was in a position to oversee the AEC proposal to site a nuclear waste repository in New Mexico. The first chairman of the GTEC was Louis Rosen of Los Alamos Laboratory. In the wording of its charter, the GTEC's purpose was "to examine ways and means of enhancing technical excellence in the state universities of New Mexico....and to promote a healthy, clean and prosperous

post-industrial economy in the state.”<sup>42</sup> In 1973, Governor Bruce King formed a subcommittee of GTEC<sup>43</sup> chaired by Gale K. Billings, chairman of the Geoscience Department of the New Mexico Institute of Mining and Technology “to look at what became WIPP.”<sup>44</sup> Cargo recalled that “in those days there wasn’t much concern over nuclear waste.” He remembered Senator Clinton Anderson of New Mexico commenting, “I wouldn’t worry about that,” during a discussion on the topic. During his term as governor, Cargo was “trying to rescue the potash industry” in the face of competition from potash producers in Israel and the Belgian Congo (Zaire from 1971 to 1997, and since 1997 République Démocratique du Congo), and had formed an international marketing consortium in collaboration with Premier Ross Thatcher of Saskatchewan.<sup>45</sup>

Thus by early 1975 the stage was set for the initiation of what was then called the Bedded Salt Pilot Plant (BSPP). ORNL and the USGS had drilled two test holes in the Los Medanos site and declared that it was an acceptable geologic location. ERDA had replaced the AEC and its officials were anxious to proceed with investigations of deep geologic disposal of defense wastes. New Mexico was a propitious location because the state government and the majority of the Carlsbad community supported the building of the repository in their area. The community support was based on the area’s dependence on the potash mines and the feeling that the potash ore would eventually be exhausted.

Potash was discovered in New Mexico following World War I after the town of Eddy had changed its name to Carlsbad “to capitalize on the reputation of a famous European resort,” writes Richard Rhodes:

...its waters were similarly brackish, and in those days, soaking in mineral water was a fashionable cure for a long list of ills....Carlsbad’s initial disadvantages were semidesert land and brackish water, and it thrived for a time on both. Then in 1912, when the spa fad was in decline, an oil wildcatter drilling east of Carlsbad tasted his drilling wastes and discovered them to be potash—potassium salts, an important fertilizer—the first such find on Federal land in the United States.<sup>46</sup>

Rhodes errs in the date he cites for the discovery of potash in New Mexico, as well as the circumstances. Potash was actually discovered in Eddy County after considerable investigation and exploration in the mid 1920s by the U.S. government. Prior to World War I, most of the world’s potash resources and production were in Germany. Originally used principally in the chemical industry, potash achieved greater importance during the 1920s in the manufacture of fertilizers for agriculture. In 1915, the Germans placed an embargo on potash exports, an act that increased U.S. efforts to seek out domestic supplies. During the war, U.S. potash production increased dramatically. In 1918, 128 plants were producing 55,000 tons of potash annually. Following the war, America reverted back to its prewar reliance on foreign supplies until by 1922 only 12 U.S. plants were producing potash. In

1918, Nebraska furnished 53 percent of the total domestic output of potash, while California provided 34 percent, with minor amounts from other states and Puerto Rico.<sup>47</sup>

In 1925, potash was discovered in Eddy County in a well drilled by the Snowden & McSweeney Oil Company under a government oil and gas permit held by V.H. McNutt. The potash shown on the drill cuttings was so positive that the first potash core test was started on April 14, 1926. In June of that year, the Federal Potash Exploration Act was approved and, in late July, the first government drilling locations were initiated in New Mexico. The American Potash Company was formed in 1926 to follow up on the discovery of the Snowden & McSweeney core test. The company was incorporated in 1930 as the United States Potash Company, later owned by Mississippi Chemical Corporation, one of the two companies still operating in 1999 in the Carlsbad Potash District. Production started in early 1931 and the first commercial shipment from New Mexico was in March of that year. Through the 1930s and 1940s, the Carlsbad potash industry improved mechanization, capacity, and productivity of their plants until by 1944 New Mexico had outstripped all other domestic potash producers, furnishing 85 percent of the total national production. The highest production year recorded in New Mexico was 1966 with a total production of 5.7 million tons.<sup>48</sup> However, by the 1970s imports of cheaper foreign potash began increasing again, especially from Saskatchewan, Canada. The decade of the 1970s was marked by a steady decline in the New Mexico potash industry as foreign producers continued to encroach into the domestic markets, which had historically been supplied by domestic producers.<sup>49</sup>

Consequently, Carlsbad city officials were actively seeking additional economic activity, and at the time felt that some of the mined-out potash mines could be used for radioactive waste storage, as experiments at the Asse potash mine in West Germany were evaluating. Carlsbad community leaders had expressed to Governor King their support for locating the repository in their area, and the state administration was not opposed to such an activity as long as it could be demonstrated to be safe. The Carlsbad area had additional advantages such as a long-term familiarity with mining activities, community support, and an economic boost for the area to offset declining employment in the potash mining industry. And as a final bonus, the state had two major ERDA engineering defense installations, Sandia Laboratories and Los Alamos Laboratory, which generally enjoyed the confidence of the local population.

## Notes

1. F.G. Gosling and Terrence R. Fehner, "Closing the Circle: The Department of Energy and Environmental Management, 1942-1994," draft, Washington, D.C., Executive Secretariat, Department of Energy, 1994, p. 9, WIPP Collection (WC), Sandia Corporate Archives (SCA).
2. "Report of the Safety and Industrial Health Advisory Board," April 1948, AEC Secretariat Files, Box 1232, quoted in Gosling and Fehner, "Closing the Circle," p. 8.
3. Sect. 1(a) and 2(c), Atomic Energy Act of 1946 (Public Law 585), 78th Cong., 1st sess., WC, SCA.
4. *The Disposal of Radioactive Waste on Land*, Report of the Committee on Waste Disposal of the Division of Earth Sciences, publication 519 (Washington, D.C.: National Academy of Sciences-National Research Council, September 1957), p. 4, WC, SCA.
5. H.H. Hess to John A. McCone, June 21, 1960, in letter to Committee on Waste Disposal, NAS-NRC, Regarding Land Disposal of Radioactive Wastes, AEC 180/13, September 20, 1960, quoted in Gosling and Fehner, "Closing the Circle," p. 14.
6. Ibid.
7. David Halberstam, *The Fifties* (New York: Villard Books, 1993), p. x.
8. Gosling and Fehner, "Closing the Circle"; they cite the following correspondence among AEC officials: M. King Hubbert to Wolman, December 29, 1965; John E. Galley to Wolman, December 11, 1965; M.B. Schaefer to E.F. Cook, December 6, 1965 (note #41, p. 145).
9. Ibid., pp. 14-15.
10. Ibid., p. 15. Located about sixteen miles northwest of Denver, Colorado, the Rocky Flats plant was built in 1951 by the AEC to fabricate plutonium, stainless steel, beryllium, and uranium alloy components. Now known as the Rocky Flats Environmental Technology Site, the facility no longer has a production mission; its present task is to clean up its nuclear and chemical contamination, and decommission and close down the site altogether by 2006.
11. Ibid.
12. *New York Times*, June 27, 1969.
13. Gosling and Fehner, "Closing the Circle," p. 15. In 1997, it became Idaho National Environmental Engineering Laboratory (INEEL).
14. Ibid.
15. Rob P. Rechard, *Milestones for Disposal of Radioactive Waste at the Waste Isolation Pilot Plant (WIPP) in the United States*, SAND98-0072 (Albuquerque, NM: Sandia National Laboratories, 1998), p. 7.
16. Public Law 102-579, 102d Cong., October 30, 1992, Waste Isolation Pilot Plant Land Withdrawal Act, Sec. 2 Definitions (20), p. 4779. The EPA initiated discussion in 1979 about changing the level from 10 to 100 nanocuries. It was officially changed by EPA when they issued their standard for geologic repositories in 1985, 40CFR191.
17. Jeff Wheelwright, "For our nuclear wastes, there's gridlock on the road to the dump," *Smithsonian Magazine*, vol. 26, no. 2 (May 1995), p. 42.

18. Gosling and Fehner, "Closing the Circle," p. 16.
19. Terrence R. Fehner and Jack M. Holl, *Department of Energy, 1977-1994: A Summary History* (Washington, D.C.: Department of Energy, 1994), pp. 13-15.
20. R.L. Bradshaw and W.C. McClain, eds., *Project Salt Vault: Demonstration of the Disposal of High-Activity Solidified Wastes in Underground Salt Mines*, ORNL-4555 (Oak Ridge, TN: Oak Ridge National Laboratory, 1971).
21. William W. Hambleton, "Historical Perspectives on Radioactive Waste Management," *Kansas Water News*, vol. 23, nos. 1 and 2 (1981): 5, WP, SCA.
22. Robert V. Guzowski, E-mail, November 17, 1997, WC, SCA.
23. Les Hill, "Background on the Waste Isolation Pilot Plant (WIPP): History-Objectives-Accomplishments-Status," p. 2, submitted by Delacroix Davis, Jr., Director, Nuclear Materials and Waste Management Division to Donald Vieth, Chief, Waste Repository Branch, April 21, 1977, WC, SCA.
24. Gosling and Fehner, "Closing the Circle," p. 16.
25. Wendell Weart, interview, May 28, 1996, Oral History Collection (OHC), SCA; *see also*, Hambleton, "Historical Perspectives on Radioactive Waste Management," pp. 2-11, especially pp. 4-6 for a discussion of the Lyons site; and Luther J. Carter, *Nuclear Imperatives and Public Trust: Dealing with Radioactive Waste* (Washington, D.C.: Resources for the Future, 1987), pp. 65-71.
26. The USGS identified and evaluated four areas in east-central and southeastern New Mexico before settling on the Los Medanos site. These are discussed in four reports: A.L. Brokaw, et al., "Geology and hydrology of the Carlsbad potash area, Eddy and Lea Counties, New Mexico," U.S. Geol. Surv. Open-file report 4339-1 (1971); C.L. Jones: "Salt deposits of Los Medanos area, Eddy and Lea Counties, New Mexico," U.S. Geol. Surv. Open-file report 4339-7 (1973); idem, "Salt Deposits of the Mescalero Plains Area, Chaves County, New Mexico," U.S. Geol. Surv. Open-file report 74-190 (1974); idem, "Salt deposits of the Clovis-Portales area, east-central New Mexico," U.S. Geol. Surv. Open-file report 74-60 (1974).
27. R.J. Hart, manager, Oak Ridge Operations to A.L. Guenther, Albuquerque District, US Army Corps of Engineers, November 13, 1973, binder "Sandia Laboratories R.W.P.P. No. 1203," Inactive Record Transfer (IRT) box/index No. 123921, Sandia WIPP Central Files (SWCF).
28. "Los Medanos" is Spanish for sand dunes. In some WIPP documents, it occasionally appears with a tilde over the n as "Los Medaños," a result of erroneous pronunciation. In this narrative, the correct spelling is employed.
29. "Real Estate Planning Report: Bedded Salt Pilot Plant Project, Atomic Energy Commission, Carlsbad, New Mexico, Department of the Army, Albuquerque District, Corps of Engineers, 10 May 1974," p. 3, binder "Sandia Laboratories R.W.P.P. No. 1203," IRT box/index No. 123921, SWCF.
30. For a detailed geological description of the Delaware Basin, *see* Dennis Powers, et al., *Geological Characterization Report, Waste Isolation Pilot Plant (WIPP) Site, Southeastern New Mexico*, SAND78-1596, Volume 1 (Albuquerque, NM: Sandia Laboratories, August 1978), pp. 3-60—3-62.
31. *Lab News*, November 14, 1975, p. 1.
32. Steven J. Lambert, "An Introduction to the General Geology and Karstic Features of Evaporites in the Delaware Basin, Southeastern New Mexico," May 14, 1990, p. 1, WC, SCA.

33. *Final Environmental Impact Statement: Waste Isolation Pilot Plant*, DOE/EIS-0026 (Washington, D.C.: U.S. Department of Energy, October 1980), pp. 1-3-1-4.
34. Gosling and Fehner, "Closing the Circle," p. 17.
35. Hill, "NAS/NRC Report: The Disposal of Radioactive Waste on Land," p. 3.
36. "Both the geologic repository operations area and the postclosure controlled area shall be located in and on lands that are either acquired lands under the jurisdiction and control of DOE, or lands permanently withdrawn and reserved for its use." 48 FR 2822, June 21, 1983, as amended at 61 FR 64268, Dec. 4, 1996.
37. Gosling and Fehner, "Closing the Circle," p. 21.
38. Ibid.
39. Les Gapay, "Government Ponders How to Safely Dump Toxic Nuclear Waste," *The Wall Street Journal*, July 26, 1976, p. 1.
40. A.G. Milnes, *Geology and Radwaste* (London: Academic Press, 1985), p. 284; see also, Charles D. Hollister and Steven Nadis, "Burial of Radioactive Waste under the Seabed," *Scientific American* (January 1998): 60-64; Steven Nadis, "The Sub-Seabed Solution," *Atlantic Monthly*, October 1996, pp. 28-30, 38-39; Leo S. Gomez, A. Aristides Yayanos, and Douglas W. Jackson, "Subseabed Disposal of High-Level Nuclear Wastes," *Advances in Radiation Biology* 13 (1987): 355-402; *Feasibility of Disposal of High-Level Radioactive Waste into the Seabed*, vol. 1: Overview of Research and Conclusions (Paris: Nuclear Energy Agency, Organisation for Economic Cooperation and Development, 1988).
41. David Cargo, telephone conversation, November 11, 1997, WC, SCA.
42. Executive Order No. 2-20, Office of the Governor, Santa Fe, New Mexico, May 26, 1970, David Cargo Papers, Box 2, Folder 190, New Mexico State Records Center and Archives; "Post-Industry Plan Will Be Explored," *Albuquerque Journal*, June 30, 1970, p. B-8.
43. Executive Order No. 71-23. Office of the Governor, Santa Fe, New Mexico, November 1, 1971: Bruce King Papers, Committee on Technical Excellence, Box 101, Folder 1225, New Mexico State Records Center and Archives.
44. Wendell Weart, E-mail, November 6, 1997, WC, SCA.
45. David Cargo, November 11, 1997.
46. Richard Rhodes, "Waste of the Pecos," *Playboy*, August 1979, p. 132.
47. Jim Walls, "Overall View of Carlsbad Potash," draft, 1983?, pp. 2-4. Walls was a former Mississippi Chemical mine manager who later worked for Westinghouse on WIPP, WC, SCA.
48. Ibid., p. 4-6.
49. Ibid., pp. 9-10.



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A Geotech employee recording geologic data in an experimental drift being drilled by a rotary boring machine.



# Chapter I

## WIPP'S EARLY YEARS (1975 – 1979)

*Sandia has no intention of studying things to death.*  
William P. Armstrong, ALO Project Coordinator

### **Before WIPP: Origins of Sandia National Laboratories (1945–1974)**

The choice in 1974 of Sandia Laboratories as principal scientific advisor to the Waste Isolation Pilot Plant was a direct result of the unique capabilities it had acquired during its previous thirty years of nuclear weapon design and testing. It was established in 1945 as the ordnance engineering and field test support arm of Los Alamos Laboratory in the nuclear buildup days following the Manhattan Project—in short, Sandia was responsible for the nuts-and-bolts needs of the U.S. nuclear arsenal. Its core mission was to support the nuclear design laboratories—Los Alamos and, after 1956, Lawrence Livermore Laboratory in California—by converting their nuclear designs into increasingly safer, more secure, and more reliable weapons.

As an offshoot of Los Alamos Laboratory, the far more renowned secret installation where the first two atomic bombs were designed and built, Sandia came into being concurrently with the beginnings of the Cold War. It was originally Z Division of Los Alamos, the engineering and field testing group, which was established in 1945 at Sandia Base, an Army Air Corps installation near Albuquerque, some 100 miles south of Los Alamos. From this small engineering group formed in the waning days of World War II, Sandia grew impressively as international tensions increased in the 1950s and 1960s. By the 1970s, it employed some 7000 people in its main facility in Albuquerque and another 1000 in Livermore, California. It also operated test ranges in Tonopah, Nevada and Kauai, Hawaii.

Unlike Los Alamos, whose eminent scientists from the beginning had a strong sense of the historical significance of the task they were undertaking, the young Manhattan Project engineers and technicians who arrived at Sandia Base had no such lofty pretensions. The bleak, wind-swept military base had been a part of the prewar Oxnard Field, Albuquerque's old municipal airport. In the words of Jack Howard, who was one of this first group and later a Sandia executive vice-president, "Given the confusion of what we were really all about, it shouldn't be

surprising that, at least for me, it wasn't too easy to imagine [being ] 'engaged in a historic endeavor'; like doing WHAT? Anyway, I was in my mid-twenties and probably only gave passing thought to such weighty matters."<sup>1</sup>

The decision to physically separate weapons research and development from Los Alamos's nuclear design groups was made in the spring of 1945 by Robert Oppenheimer, who explained, "We wished to make provision for the continuation of weapons development, especially in its non-nuclear aspects, at a site convenient to Los Alamos—as Wendover\* was not—immediately accessible to aircraft and air strips, and not itself part of Los Alamos."<sup>2</sup> A major factor in the decision was no doubt the cramped and uncomfortable conditions in Los Alamos itself, and the attendant lack of water and other amenities. Neighboring Santa Fe, the state capital and today a trendy spot favored by artists, skiers, and Hollywood types, had limited facilities, and even though a good two-lane paved road connected it with Los Alamos, the commute was still tedious. And Albuquerque, with its 30,000 inhabitants, was a veritable metropolis by comparison, albeit still relatively isolated from the nation's major urban centers.

Albuquerque's geographical isolation but much more convenient military air facilities made it an ideal site for Los Alamos's Z Division, named after the first letter in the last name of its group leader Jerrold Zacharias. The war years had seen considerable activity at the Army Air Corps base after the Secretary of War appropriated 1,100 acres of land in 1942 on Albuquerque's east mesa, which included Oxnard Field. It was in this era that the term "Sandia Base" came into unofficial use by the construction crews who were erecting the facilities.

Z Division of Los Alamos was moved to Sandia Base in 1945. On April 1, 1948, Z Division was reorganized as Sandia Laboratory, a branch of Los Alamos.<sup>3</sup> At this juncture, the personnel strength of the Sandia Branch was 470, although by a vigorous recruiting effort the number of employees exceeded 1000 by the fall of 1948. A \$25 million construction program began to build permanent structures to replace the flimsy buildings erected by the Manhattan Engineer District. Norris Bradbury, director of Los Alamos, was disturbed by Sandia's rapid expansion, which gave the branch a staff nearly equal to that of the parent laboratory. The University of California also shared this concern, concluding that Sandia activities were "...no longer appropriate to an academic institution"<sup>4</sup> and requested that the facility be transferred to someone else's purview.

Atomic Energy Commission chairman David Lilienthal invited a Bell Telephone executive, Mervin J. Kelly, to survey the entire Los Alamos operation. Kelly's

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\* Wendover airfield in Utah. This was the headquarters of the 509th Composite Group which had supplied the crews and aircraft for the atomic bombings of Hiroshima and Nagasaki. Bomb ballistics testing was also carried out at Wendover.

recommendation for Sandia was that it would be more effectively managed as a production-type organization under industrial management. The AEC then decided to ask the Bell System to assume management of Sandia, which prompted Harry Truman's brief letter of May 13, 1949, to AT&T president Leroy Wilson asking him to assume direction of the laboratory. This letter contained the sentence, "In my opinion you have here an opportunity to render an exceptional service in the national interest," the last part of which has become Sandia's oft-used motto.

Thus in 1949 AT&T stewardship of Sandia Laboratories was initiated on a no-profit, no-fee basis. Specifically, AT&T placed Sandia under the wing of Western Electric, its manufacturing arm, which created Sandia Corporation, a wholly owned subsidiary, to manage Sandia. This was because certain policies, such as 24 days annual leave, had been established at Sandia under University of California management, policies that AT&T did not wish extended to Western Electric. AT&T saw Sandia's role as primarily production, which is why it initially sent a Western Electric management team headed by George Landry, Sandia's president from 1949 until 1952.

Consequently, there was a difference of opinion between the Western Electric transferees and most Sandia employees as to Sandia's basic mission. In Jack Howard's colorful phrasing, "...we stepped off on the wrong foot....Even before time itself began to erode the manufacturing-mission image for Sandia, it dawned on a few...probably most notably Mervin J. Kelly and perhaps Don Quarles...that the role that needed to be filled was one of providing engineering expertise to AEC....It was probably Kelly who substituted physicist Quarles for factory-manager Landry."<sup>5</sup> The second person that Howard refers to is Donald Quarles, who succeeded Landry as president in 1952. Quarles came from Bell Labs where he had been supervising the Nike missile electronic-guidance project. He reorganized Sandia to emphasize engineering research over production in conformance with an AEC directive that Sandia no longer would produce war reserve weapons although it retained final oversight on their production. Quarles left Sandia to become Secretary of the Air Force, and then Deputy Secretary of Defense. He died of a heart attack in 1959 on the day President Eisenhower was going to appoint him Secretary of Defense.

By the 1950s, propelled by Korean War pressures, Sandia's work schedule increased to six days a week under intense, secretive conditions. The staff was about 4,000 with an average age of 32 and most of its middle managers were electrical engineers. These were the years of the Eisenhower administration when nuclear weapon design and production was at its peak. In 1950, the AEC established the Nevada Test Site (NTS) northwest of Las Vegas for the testing of nuclear weapons. Sandia scientists were assigned to study blast and other weapon effects of surface and atmospheric tests at the new site.

Nuclear field testing actually began with the Trinity detonation on July 16, 1945.<sup>6</sup> By the summer of 1946 when the Operation CROSSROADS nuclear tests were

conducted at Bikini in the Pacific Ocean, Glenn Fowler had created a field test group at Sandia while it was still part of Los Alamos. Fowler, who went on to a prominent and distinguished career as vice-president at Sandia, has been described as an “excellent supervisor who was able to judge well the capabilities of men and give them responsibility in a manner that made them determined to succeed.”<sup>7</sup> These were the beginnings of Sandia’s non-nuclear field test operations, which were continued at Salton Sea in California and later transferred to Tonopah Test Range in Nevada.<sup>8</sup>

In 1958, President Eisenhower announced a unilateral moratorium on nuclear testing and called upon other nations to join. The United States and the Soviet Union then agreed to suspend nuclear testing on November 1, 1958. When the Soviets resumed testing in 1961, the U.S. followed suit. This pattern of nuclear brinkmanship reached a frightening denouement in the Cuban Missile Crisis of 1962 during John F. Kennedy’s administration. The following year the U.S. and U.S.S.R completed negotiations for a limited test ban treaty prohibiting nuclear testing in the atmosphere, space, and the oceans, thus restricting testing to deep underground sites. NTS therefore became the U.S.’s principal locale for testing of nuclear weapons, and Sandia’s study of the phenomena associated with underground testing intensified.

Since the AEC and Sandia knew that there were potential ways of attempting to conceal or disguise underground nuclear tests, it was necessary to acquire expertise in those areas to understand the potential for clandestine underground testing. So in 1959 Sandia began hiring earth scientists, particularly seismologists like Wendell Weart, an Iowa native who was completing his doctoral dissertation at the University of Wisconsin. Weart was born in Brandon, Iowa—a “bustling metropolis of 321 people” during the Depression years. He spent his summers working on a farm, “driving horses and tractors to harvest hay and cultivate corn fields.” He attended Cornell College, a small institution of fewer than 1000 students in northeastern Iowa, about 50 miles



*Wendell Weart is at the left in this 1963 photograph taken at the Nevada Test Site during the Shoal underground test. The other Sandians are (left to right) William Perret, John Eckhart, Paul Kintzinger, and Ben Benjamin.*

from Brandon. From there Weart went to the University of Wisconsin, receiving a Ph.D. in geophysics in 1961—one of the first Sandia-sponsored thesis projects.<sup>9</sup>

At the time Sandia did have one earth scientist (Robert Smith) on the payroll, but he was not a geophysicist or a seismologist and his work did not involve earth science, making Weart the only practicing earth scientist at Sandia. Due to the urgency of adding this staff expertise, Weart actually conducted field studies and completed his dissertation while working at Sandia. His first active nuclear field test was a 1961 underground test designated GNOME, in southeastern New Mexico. His next assignment was at NTS, while the moratorium was in effect. As Weart described it, he did “some post-shot reentry work on an event that had already been conducted and to see what worked and what didn’t work in the way of confining the radioactivity from these tunnel shots.” This led to the work that Weart would pursue for the next fifteen years: investigating the phenomenology of underground explosions, which entailed the measurement and prediction of ground motion from underground detonations, and later the study of how the radioactive products of these underground detonations could be confined and contained.<sup>10</sup>

## **Sandia Gets the Call**

Sandia management was aware of the AEC’s increasing interest in locating a repository in southeastern New Mexico and the potentially important role it might be called upon to play. Morgan Sparks, president of Sandia, was chairman of the Governor’s Technical Excellence Committee (GTEC), and on August 29, 1973, he appointed Wendell Weart to serve as the geophysicist on the subcommittee that had been formed to monitor the AEC geologic investigations for a waste repository in the Los Medanos area being conducted by Oak Ridge National Laboratory (ORNL).<sup>11</sup>

In late 1974, Frank Pittman, Director of ERDA’s Division of Waste Management and Transportation, asked AEC’s Albuquerque Operations Office (ALO) to accept overall administrative responsibility for the Radioactive Waste Pilot Plant, as it was then called. Sandia Laboratories, in turn, was assigned technical responsibility for developing the repository. The program was given to ALO and Sandia for several reasons. Both organizations were well known within New Mexico and enjoyed a good reputation in the state. Also, it was believed that the primary task remaining to be accomplished was to engineer a large-scale field facility—an area in which Sandia had extensive experience from setting up the Salton Sea and Tonopah test facilities. Another reason was that it made good sense to have an in-state laboratory involved for “logistic, political, and public relations reasons.” ALO and Sandia management, recognizing the critical national need for this facility and Sandia’s unique qualifications to undertake the project, agreed to assume responsibility for site confirmation, conceptual design, supporting technical studies, and preparation of an Environmental Impact Statement.<sup>12</sup>



Just exactly how Sandia was approached to participate in the budding project seems to have been rather informal. Albert W. Snyder, Sandia's director of Nuclear Fuel Cycle Programs between 1973 and 1990, recalled that "Sandia was first approached to take on project responsibility by a phone call from Owen Gormley, who worked for Frank Pittman, to Morgan Sparks sometime between midnight and 2 am. The conversation was rather circuitous and not to the point, and Morgan became increasingly impatient with the caller and it finally did surface that this phone call was an overture for Sandia to take on program responsibility."<sup>13</sup>

According to Snyder, the phone conversation between Gormley and Sparks was followed "within a matter of days" by a meeting at Sandia. The attendees were Sam Donnelly, head of the Albuquerque Operations Office, Pittman, Gormley, Sparks, and Snyder. Donnelly asked Pittman to describe the objective of the proposed repository, to which Pittman replied that it was "first and foremost" for the disposal of radioactive waste from the Defense Program. When Donnelly pointedly asked about commercial waste, Pittman's response was that "if the first priority of this program moves along smoothly technically and politically, then we'll raise the issue of commercial waste disposal at this site."

To which Donnelly, using a few words on the fringes of profanity, said, "Absolutely not! If we were going to be responsible in New Mexico for this project, we were going to be forthright about its objectives [which] would not be changed with time because that would erode the credibility that we were being asked to bring to the table."<sup>14</sup>

As a consequence of the Donnelly position, Sandia was instructed to begin development of a transuranic-only waste repository but also to conduct the site studies in a way that would not rule out future consideration of high-level waste (HLW). Future development illustrated the wisdom of Donnelly's concern as DOE proposals to use WIPP for HLW generated congressional, state, and public concern and distrust over DOE's intentions for the repository.

Sandia responded to Gormley's phone call and the subsequent meeting by writing a proposal for the transition of the repository project from ORNL to Sandia. Responsible for this proposal, Snyder and Tom Hunter were among the first Sandians to be assigned to the project. In 1974 both Hunter and Weart were assigned to the underground testing group at NTS. One of Hunter's jobs was to support Snyder in developing new programs in nuclear-related matters. Hunter, Peter McGrath, and Bill Bishop wrote the project proposal, which included the transition from the current program in Lyons, Kansas, the conceptual design approach, and the geotechnical siting studies. "I worked on the project from December 1974 to June 1975," recalled Hunter. "We set up the project, assembled a team from across the labs. We got Wendell, he was on GTEC. We got Leo Scully, just back from Tonopah. Much of our work at the time was the transition from ORNL [in Los Medanos]."<sup>15</sup>

Transferring responsibility for the project from ORNL to Sandia required a certain amount of diplomacy. "They [ORNL] were not extremely happy, as I remember,

having lost this fairly major project,” recollected Hunter.<sup>16</sup> In a letter to Wayne Knowles, head of the Engineering Branch, ERDA Division of Waste Management and Transportation, William P. Armstrong, ALO Project Coordinator, wrote: “...I got the impression that you had fears in regard to Sandia ‘reinventing the wheel’ so to speak....I have emphasized to Wendell Weart that we expect Sandia to use the expertise gained by Oak Ridge.” In what time would show to be an overly optimistic statement, Armstrong replied that “Sandia has no intention of studying things to death.” Continuing, he expressed his reluctance to send copies of the ALO-Sandia Program Plan to ORNL for review:

I do not wish to give our laboratory [Sandia] the impression that ERDA wants Oak Ridge to be looking over their shoulder and that Oak Ridge has a responsibility for the program other than what has been delineated to us and to Sandia, namely, that Sandia use Oak Ridge’s expertise gained from its work in bedded salt.<sup>17</sup>

So with three earth scientists, one of them Weart, on the payroll but two additional geologists (George Griswold and William C. Vollendorf), Sandia agreed in December 1974 to take full responsibility for the facility concept and for studying the geology and hydrology of Los Medanos to determine its suitability for building a radioactive waste repository there. Sandia began its planning efforts in January 1975. ERDA funded Sandia on March 28, 1975, to initiate work on “a Radioactive Waste Disposal Pilot Plant to be developed in Southeastern New Mexico....The project was conceived at such a late date in the fiscal year that the funds to be expended require[d] a concentrated effort during the months of April, May, and June on the part of project personnel.” Sandia’s project goals that summer of 1975 included the selection of engineering consultant firms and ecological and biological subcontractors, which had to be completed by the end of June. The first Sandians on the project were Wendell Weart, Les R. Hill, George Griswold, Dennis Powers, William C. Vollendorf, Vernon E. Kerr, Leo W. Scully, Paul O’Brien, and Robert E. Stinebaugh.<sup>18</sup> The geologists in this group, besides Weart, were Griswold and Vollendorf. The group assigned to writing the Environmental Impact Statement comprised Melvin Merritt, Felton Bingham, and Don Matejka.

One indication that “...the communications between Sandia and [ERDA] Headquarters were very poor, in fact, almost nonexistent...” during this early phase of the project is revealed by remarks penned by Leo Scully after a meeting with Wayne Knowles:

He [Knowles] indicated that, because of their own lack of knowledge of their role in the waste management...area, they would not give Sandia direction, guidance, comments or criticism about our Program Plan. We will be left to our own devices and direction until such time as their role is firmly established; they would then issue commands and direction, which may be drastically different than what we had been pursuing. He indicated that others (and these other people were not identified) were criticizing Sandia for reengineering/redesigning the wheel and indicated that we were really overdoing the job.<sup>19</sup>



*In 1974, just prior to joining the WIPP project, Wendell Weart (center) was involved in Sandia's oil shale research. His colleagues are Dave Northrop (left) and Hap Stoller (right).*

Weart first learned that he had been put in charge of the project when Glenn Fowler called him to his office in December 1974 and told him that “they [Fowler and the rest of Sandia management] had decided to offer me the opportunity of being the project manager...because they felt I had the right combination of technical background and ability to work in a cooperative and capable manner with people who might be very much opposed to this project, and anyway I did decide to take the job.” Weart wasn’t sure how much of an option he really had, but he always remembered one piece of advice that Fowler gave him: “Always level with the public. They’re smarter than you may think and if you try to dissemble or gild the lily, or you try to make things come out sounding favorable and they really aren’t, they’ll see through you.”<sup>20</sup> As soon as he was put in charge of Sandia’s role in what in 1975 was being called the Radioactive Waste Disposal Pilot Plant (RWDPP), Weart resigned from the GTEC subcommittee that had been formed to monitor the activities at Los Medanos.

## Geologic Studies and Site Selection in Southeastern New Mexico

In early 1976, ERDA announced that it had decided to build what was in January officially designated as the Waste Isolation Pilot Plant or WIPP, and that its location would be in the bedded salt deposit underneath Los Medanos. ERDA’s intention was to use the facility for the ultimate disposal of transuranic wastes from the defense program and to carry out research and development for other defense radioactive waste materials in salt. The data derived from the experiments would “...hopefully verify the concept of long-term isolation of these wastes from



*Location map, showing the Waste Isolation Pilot Plant in southeastern New Mexico*

the biosphere.”<sup>21</sup> At this time, ERDA and Sandia anticipated that construction of the WIPP facility would be complete by “...the third quarter of FY '83,” sometime between July and September.<sup>22</sup>

When in mid 1975 Sandia was assigned to carry out the scientific studies and site selection at the Los Medanos site, it put together a team consisting of the persons already mentioned previously. The emphasis at this time was on site selection which was principally put on the shoulders of George Griswold, a former professor of Mining Engineering at New Mexico Technical Institute in Socorro who had previously worked with the potash and oil industry. Griswold was directly overseeing the site selection work.

The WIPP site studies included several concurrent activities. The abovementioned site selection was under Griswold's purview. Robert Statler directed drilling operations which were assigned to contractors. Field test encompassed setting up meteorological stations to gather weather data for the Environmental Impact Statement (EIS) under the direction of Mel Merritt; ecological studies were carried out by Pat Brannen and environmental studies by Sieglinde Neuhauser and Felton Bingham. Leo Scully was responsible for the conceptual design, that is, what the facility was going to consist of and how it would all come together.

From 1975 to 1978 Les Hill was the manager responsible for the site evaluation studies and development of technical support programs, the latter afterward taken over by Tom Hunter. He supervised a division that oversaw the drilling of over 50 boreholes, laboratory tests, in situ investigations, and environmental monitoring programs. Originally from upstate New York and armed with a Master's degree in civil and geological engineering and Ph.D. in mathematics and mechanics, both from Princeton, Hill went to work for Sandia in 1967. In the 1960s, Hill's main work, together with Weart and Melvin Merritt, had been in underground testing at NTS. In 1971, they were involved in the CANNIKIN event, an underground nuclear test at Amchitka Island in Alaska, which was “the biggest underground nuclear event the United States ever set off—so big it could not be fired in Nevada. [It] was like five megatons, 6,000 feet deep,” Hill recalled. “In CANNIKIN...we were worried about an immediate event on the order of milliseconds [and] microseconds compared to 50,000 years at WIPP. Could the radionuclides leak under the Aleutian Islands into the ocean and get to the fish?”<sup>23</sup> All three were members of the AEC's Containment Review Committee for Project CANNIKIN, and the knowledge gained from this event and other underground tests would serve in good stead for their future work with WIPP.

## **Project GNOME**

A 1961 underground nuclear test called GNOME also yielded data that were to provide valuable insights a decade later for the WIPP project. It was an “offsite”

test, meaning it was not at NTS or the Pacific Proving Ground. In fact, GNOME was carried out in southeastern New Mexico not far from where the repository investigations were to be done a decade later. And, interestingly enough, Weart was the scientist in charge of strong ground motion experiments for the shot. The GNOME test was the first of a series of underground detonations in support of the Plowshare Program for the use of nuclear explosions for peaceful purposes. Plowshare had been proposed by Lawrence Livermore Laboratory scientists before the moratorium on atmospheric testing of nuclear bombs in 1958, but interest in this activity increased after the Limited Test Ban Treaty was signed in 1963. The United States Geological Survey (USGS) carried out extensive geologic investigations in the early 1960s in support of the emplacement of the Project GNOME device. The characterization of the salt beds was a necessary precursor to the shot, and the investigations done there “increased...knowledge of southeast New Mexico geology and hydrology immensely.”<sup>24</sup>

*The author and Wendell Weart at the GNOME site in 1996. The weather-worn inscription reads:*

UNITED STATES ATOMIC ENERGY  
COMMISSION  
DR. GLENN T. SEABORG, CHAIRMAN

PROJECT GNOME

DECEMBER 10, 1961

THE FIRST NUCLEAR DETONATION IN THE PLOWSHARE PROGRAM TO DEVELOP PEACEFUL USES FOR NUCLEAR EXPLOSIVES WAS CONDUCTED BELOW THIS SPOT AT A DEPTH OF 1216 FEET IN A STRATUM OF ROCK SALT. THE EXPLOSIVE EQUIVALENT TO 3,100 TONS OF TNT WAS DETONATED AT THE END OF A HORIZONTAL PASSAGE HEADING FROM A VERTICAL SHAFT LOCATED 1,116 FEET SOUTHWEST OF THIS POINT. AMONG THE MANY OBJECTIVES WAS THE PRODUCTION AND RECOVERY OF USEFUL RADIOACTIVE ISOTOPES. THE STUDY OF HEAT RECOVERY, THE CONDUCT OF NEUTRON PHYSICS EXPERIMENTS, AND THE PROVISION OF SEISMIC SOURCE FOR GEOPHYSICAL STUDIES.

*A second, smaller plaque reads:*

NO EXCAVATION AND/OR DRILLING IS PERMITTED TO PENETRATE SECTION 34, TOWNSHIP 23 SOUTH, RANGE 30 EAST, NEW MEXICO PRINCIPAL MERIDIAN AT ANY DEPTH BETWEEN THE SURFACE AND 1,500 FEET.



Project GNOME had its problems, though. Carlsbad's newspaper, the *Current Argus*, editorialized: "Eminent scientists have concluded that the [GNOME] explosion will be fully contained in the salt bed, that no radioactive material will escape and that underground formations will not be damaged."<sup>25</sup> GNOME was a "modest" three-kiloton explosion 1200 feet underground, about seven miles from the future WIPP site. Scientists and dignitaries from around the world had gathered at an observers' station four miles away, including Edward Teller who the previous evening had assured the citizens of Carlsbad that the experiment was perfectly safe. According to Weart: "The GNOME event was conducted in the Salado formation on December 10, 1961. This experiment failed to contain completely. Water vapor containing the noble gases and more volatile fission products was vented through the emplacement shaft beginning about four minutes after detonation."<sup>26</sup> Asked by a reporter what that was coming out of the ground, Weart replied, "It appears to be white smoke."<sup>27</sup>

## Continuing Site Studies

Les Hill initiated what he called the "sunrise services"—Monday morning meetings at 10 minutes to 8 in Building 800, Sandia's administrative building. These meetings were for the purpose of planning the upcoming week's work at Los Medanos and reviewing the previous week's activities.

...I would go around when we were breaking up at 8:10 and say, "Okay, we're spending a lot of taxpayers' money, so has anyone found in the last week any reason why the proposed...project is not viable? I want to know now before we spend any more...money." And we would go around the room and talk about things I really thought were important...that if this is not going to work, let's pull the plug on it now. A number of us after this meeting caught the plane to Carlsbad and it was almost a steady diet, every Monday morning.<sup>28</sup>

Once Sandia had collected a critical mass of staff people in mid 1975, it proceeded to carry out geological explorations to verify ORNL's data on its recommended site. ORNL scientists had drilled two experimental holes, AEC-7 and AEC-8, and Sandia had assumed custody of the rock samples, or core, obtained from these test drillings. This core was stored in a portion of a meat market in Carlsbad which had formerly been used as project offices for the GNOME event. One of Sandia's first tasks was to remove and better preserve the core.

The remaining corners of the ORNL site had not been explored, so Sandia decided to drill the northwest corner because that was the closest point to the known reserves of potash in the area. Wendell Weart, directing the overall project, remembered that Sandia's understanding when it first accepted the project was quite different from what eventually developed:

When we inherited this project, we were told that a site had been identified, that to finish characterizing it we should drill two more holes at the two corners of this rectangle that had not



yet been drilled and that we should complete a conceptual design. This should be a very modest effort on our part, and Sandia and myself thought that maybe we had a six-year effort on our hands here, and most of that job involved the conceptual design work and not site characterization.<sup>29</sup>

As it turned out, Weart's assumptions turned out to be somewhat premature.

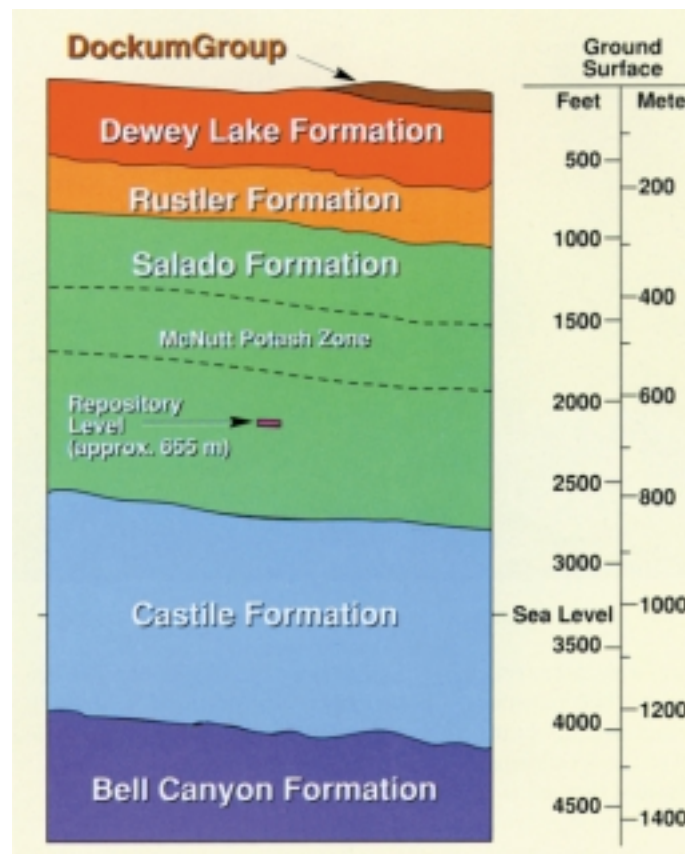
## The Infamous ERDA-6

Sandia's very first field effort beginning on June 13, 1975, undertaken to complete the characterization of the initial site, entailed the drilling of ERDA-6 in a third corner of the rectangle. This borehole immediately uncovered some unexpected geology—steeply dipping salt beds. The ERDA-6 location was seven miles north-northwest of the eventual WIPP site location. Because the repository was envisioned as being a level layout in gently inclined salt beds, the steeply dipping beds presented a serious obstacle. At the time, Sandia was contemplating developing a two-level repository with levels 500 feet apart vertically.

Although the repository's main mission was the disposal of transuranic waste, ERDA also wished to consider it for possible spent fuel or high-level waste, which would be placed at the lower level. But the steeply dipping, almost vertical, beds were just at this lower level. This discovery occasioned a series of urgently worded telegrams to ERDA Headquarters:

Sandia, on the advice of its experts, has made the technical decision that it is not feasible to continue drilling operations in light of the dangerous potential existing in the hole.<sup>30</sup>

The program was on a tight but feasible schedule for the FY 1978 budget when the geologic structure encountered in ERDA hole #6 dictated a shift in the exploratory area....site configuration has been delayed nearly one year....The project would be vulnerable to a charge of inadequate and incomplete investigation and consideration of the site-specific factors for the sake of expediency...<sup>31</sup>



*A cutaway view of the geologic formations at the WIPP site in southeastern New Mexico, showing the repository level.*

Besides revealing the unexpected geological features, the drilling of ERDA-6 led to a dramatic event. At the depth of 2711 feet, the drillers encountered brine which came gushing out of the ground under artesian pressure. This brine contained a heavy concentration of hydrogen sulfide which separated from the brine as pressures were released. Hydrogen sulfide, also called sour gas in the petroleum industry, is very toxic and can be flammable. Tom Lawes, one of the Sandians working near the wellhead, almost lost his life when he inhaled the gas. He had gone down to the mud pit to retrieve some drilling mud, and because the sour gas is heavier than air, it was concentrated near the bottom of the pit. Realizing his predicament, Lawes yelled "Get me oxygen" to his coworkers. When they responded that no medical oxygen was available, Lawes said, "Get it off the welding truck." His coworkers got the canister, stuck the tube in his mouth, and turned on the regulator so he could inhale oxygen. So he saved his own life by remembering where the oxygen canisters were.<sup>32</sup>

Besides the hazard that the presence of the brine posed for workers, it was disturbing for another reason. It raised the issue of whether fluids have migrated underground, thereby threatening the integrity of the site. *Science* magazine, in its October 1975 issue, quoted Weart, "Although many experts believe the brine was laid down hundreds of millions of years ago, others warn that it might be connected to adjacent aquifers. Age dating tests will be conducted in an effort to resolve the matter."<sup>33</sup>

Steve Lambert, a young geochemist straight out of California Institute of Technology, was hired at this time as an earth scientist to work on the repository studies. Being the only geochemist on the project, as well as the only staff scientist who had ever dealt with fluids in the subsurface during his graduate work at Caltech, he was put in charge of the whole hydrology program. Lambert recalls, "Didn't know a thing about hydrology and practically everything I had learned about hydrology was that well water occurs in rocks and sometimes it dissolves rocks into caves underground and caves were fun." Lambert's experience was not uncommon. It was also consistent with Sandia's approach to technical problems, which had been largely inherited from the Manhattan Project days—the premise that "any Sandia engineer can be given a textbook on any subject and be expected to become the local expert."<sup>34</sup> Besides, in the 1970s there were as yet no experts in the development of nuclear waste facilities.

Lambert recalls the consternation that ERDA-6 caused:

The furor that this discovery caused at headquarters in Washington could almost be heard without using a telephone because the reaction from one of the project people in charge was, "What are you trying to do, kill the site? What do you mean drilling a hole and discovering gas and brine?"<sup>35</sup>

The depth of 2711 feet at which the brine and gas were encountered was very close to the 2600-foot target depth for salt beds that were judged to have the required

purity for the deeper level excavations. This was based on data obtained from other boreholes in the region. ERDA-6 showed that there could be geologic features in this area of the subsurface that any single hole might be likely to miss. The USGS scientists working on the earlier boreholes, AEC-7 and AEC-8, had noticed some anomalies in the core extracted from those holes. First, the occurrences of the rocks which were known to be mostly flat-lying throughout the Delaware Basin were being found at increasingly shallow depths as the holes advanced. This implied there might be an upward bending structure—in geologic parlance this is known as an anticline, where the rocks form a sort of arch. The whole Delaware Basin had been known to have been tilted eastward about one degree from horizontal some 600,000 years ago. A fairly trivial dip, but at this part of the site ERDA-6 showed beds dipping more than 70 degrees from horizontal. As Lambert put it: “That’s a problem if you’re trying to drive a mine horizontally and keep it



*The future site of WIPP in 1975. This was 7 miles (11 kilometers) from the original site where Oak Ridge investigators had drilled AEC holes 7 and 8 and Sandia scientists drilled ERDA-6 encountering deformed salt beds and a brine reservoir. Sandia recommended moving the site toward the center of the Delaware Basin shown here.*

horizontal if you're trying to follow the rock layer that has the same property all the way through. That's an operational problem."<sup>36</sup>

The geologic features demonstrated by the drilling of ERDA-6 rendered the site unsuitable for a repository. This news was going to be disheartening to many people in Carlsbad. Weart, taking to heart Glenn Fowler's admonition to always be honest with the public, had the responsibility of breaking the news to them.

Sandia, having been engaged during all of its existence with secret nuclear testing, which is what Weart and the other members of his team had been doing, had no experience in interacting with the public, much less explaining its actions in a public forum. The repository work was just the opposite—a highly visible project which many people in New Mexico and across the country were keenly for or against. And the burden fell on Weart to inform the Carlsbad community that the site chosen by ORNL on which many of them had pinned their hopes for a prosperous future “..was no good, [that we] had to find another.” He recalled with some amusement that he had been chosen to head the project because he was “politically acceptable” and not exclusively because of his technical expertise. Weart's new role also revealed a straightforward and reassuring style of communicating complex technical matters to nonspecialists. George Griswold, who was responsible for field investigations at the site, paid colorful tribute to Weart saying, “I don't know of anyone in the Laboratories that could have handled it as well as Wendell—[it brought] tears in my damned eyes what this guy [was] doing.”<sup>37</sup>

Notwithstanding Weart's communication skills, some encounters were unavoidably less successful than others. A 1977 newspaper account described a radio debate at KCCC, a local Carlsbad station located at the rear of a furniture store, both operated by Marion Jenkins. The debate was between Weart and Dr. Peter Montague, a University of New Mexico architecture professor and chairman of New Mexico Citizens for Clean Air, an environmental group opposed to WIPP. The story described Weart as “...a short, stocky geophysicist...” (Weart is rather tall). The article continued, “Having sparred others on the WIPP, Weart and Montague have learned to choose their words carefully. A patient man, Weart is used to being on the defense and speaks in a slow drawl.” Still, a local anti-WIPP activist, Roxanne Kartchner, complained after the show that “Peter never had a chance to talk....And that Wendell Weart! What a master of doubletalk! The whole thing was a complete farce!”<sup>38</sup> For a decade, until 1985, Weart spoke to virtually every civic group and numerous schools in southeast New Mexico to explain the WIPP project.

## **Mixed Policy Signals and Final Site Selection**

George Griswold, identified earlier as the lead for Los Medanos site investigations, first of all had to understand what caused the deformation of the underground salt beds. It was this deformation that necessitated moving the site. Griswold projected a deceptively crusty façade behind which lurked one of the most brilliant

geologists in the region. An independent West Texas wildcatter with his father, Griswold earned a Ph.D. in geological engineering from the University of Arizona. After a stint at consulting, he was appointed chairman of the Petroleum and Mining Engineering Department at New Mexico Institute of Mining and Technology in Socorro, "...a small but academically excellent institute."<sup>39</sup>

Once Griswold, Les Hill, and the others understood the correlation of deformation with the proximity to the buried Capitan Reef, they initiated surveys of the geophysical records of the area's potash and oil and gas companies, which had been active for many years in southeastern New Mexico and had accumulated an immense amount of geophysical data. The company records were all confidential and could not be published, but they were made accessible to the Sandia geologists, which helped them determine why the original site was deformed and why other areas seemed to have favorable characteristics. As Weart described it:

So we made the initial selection basically using company information and existing geologic knowledge but which we could not ever make public because it was...confidential. It did tell us that there was a band five or six miles wide that paralleled the buried Capitan reef that showed pretty consistent evidence of deformation of these deep saltbeds and that if we wanted to improve our chances of being in an area where the beds were flat-lying, we should move outside that six-mile zone more into the center of the basin. The geophysics indicated if we did that, we'd have a very good chance of finding flat-lying beds.<sup>40</sup>

After the original site was abandoned, Weart decided that Sandia and the USGS should each do independent evaluations of seven regions that screening studies had identified as having favorable properties. These seven regions were outside the six-mile zone that probably contained deformed salt beds. Griswold did Sandia's evaluation and "fortunately," Weart said, "because it made the decision easy," both came up with the same preferred location of one of the seven regions.

Dennis Powers, a Sandia geologist, observed: "That USGS and Sandia generally worked in a highly cooperative manner for a number of years is a testimony to the working relationship between Wendell Weart, and USGS's Bill Twenhofel, Bill Hale, Richard Snyder, and Leonard 'Bud' Gard." Charlie Jones was the lead USGS geologist whom Weart recalls as a "charming guy—nobody [knew] more about the geology of the Salado...[he] knew that brine flows had been hit in that area...he knew that Mississippi [Chemical Mine Company, one of the companies mining potash in the area], U.S. Borax as it was called then, had run into a breccia pipe—he just didn't tell us. Charlie was the type of guy who had a tremendous store of information in his head, but he liked to keep that to himself and use it piecemeal." Robert Statler, director of drilling operations, opined that "...[Jones] felt honor bound to protect the privacy of these individual mines. He was just as surprised as anyone else at what we ran into in ERDA-6."<sup>41</sup>

George Griswold, who had the principal responsibility for locating a new repository site, recalled the challenges and frustrations of the process:

The National Science Foundation had said, “salt is best.” Charlie Jones is telling us that the best salt...is...at reasonable mining depth (because you can’t get below 3000 feet). What we call the infracowden salt. This is salt in the lower part of the Salado. So in my site selection, I had to find a pure salt, preferably this infracowden at less than 3000 feet. If it wasn’t less than 3000 feet, it would be the hell out in the basin...so that kept us up by the potash area. So that was a big driving force under the multiple criteria that we had—so many miles from a drill hole, trying to get away from potash, trying to get away from brine, trying to stay on federal land and off state land. The biggest technical challenge was this pure salt at less than 3000 feet, and that was very high in my selection of the red dot that finally ended up on the map. Very naively here I am going on, and Wendell invites me to a meeting and some of the Oak Ridge guys were there and...Armstrong’s boss [Delacroix Davis]. I was sitting in the back...and all of a sudden Oak Ridge announces that WIPP is not a high-level commercial waste, heat-generating bad dragon thing—I just fell out of the chair, because I thought we were the leading project to do the experimental work in salt and prove all these wonderful ideas about [it]. And I found out from Wendell, no, that was an edict, the mission had changed. I did a typical Griswold—got mad, went home, had eight martinis, came to work the next morning, and wrote a livid memo to Wendell and Del Davis. What in the hell is going on? Because if you go back to low level waste, hell, you can put this anywhere. You’ve taken away my site selection criteria, you took away the core of it. I wouldn’t have been there if you’d said it was going to be just low level waste. And they made me withdraw that memo...I kind of drifted away from the program after that.<sup>42</sup>

Griswold’s consternation was caused by the reversal of the original objective of developing a two-level repository with levels 500 feet apart vertically. What led to confusion was ERDA’s guideline that the site should not be “incompatible” with high-level waste. “The main mission was to be transuranic waste,” according to Weart, “but there was also a desire on the part of ERDA to develop this facility for demonstrating commercial waste disposal.”<sup>43</sup> This notwithstanding Sam Donnelly’s (director of ERDA’s Albuquerque Operations Office) emphatic rejection in 1974 of that proposal. However, according to Owen Gormley (deputy director of ERDA’s Waste Management Division), in the beginning the repository was conceived as a pilot plant for commercial high-level waste, with the disposal of military transuranic waste from Idaho to come only later. But as a result of controversy over the retrievable surface storage facilities (RSSF) program, ERDA in 1975 withdrew the environmental impact statement for the commercial waste program which the AEC had issued. So, on Gormley’s recommendation, ERDA also removed the Los Medanos site from the commercial program and redefined the future WIPP’s mission to that of an unlicensed facility for military transuranic waste.<sup>44</sup> This was probably the announcement that caused Griswold to write the indignant memo that was never sent. He eventually penned a more diplomatically worded memo, evidently after a “cooling-off” period, the highlights of which follow:

[I want to] express my concern that we are exploring for a site at Los Medanos while using selection criteria for a high level rather than for low and intermediate waste. A site for high level is extremely difficult to find because of the stringent requirements related to heat dissipation, and it would be an inefficient use of national resources if we reserve the best location in the Delaware Basin for simply ERDA [TRU] waste. It is my understanding that ALO and ERDA/HQ have now given clear instructions that Sandia’s mission is to establish a facility for disposal of ERDA-type waste....I have no reservation on this. Certainly a disposal facility is needed for this type waste and....the New Mexico portion of the Delaware Basin is an ideal geologic province to search for such a site. The current site was selected because pure salt beds lie at depths compatible for high-

level disposal. We also assumed that we would need some three square miles to accommodate the projected quantities of commercial waste. If we are restricted to ERDA material that can be “warehoused” then we need only a few hundred acres. The high level tests could be restricted to a thinner lens of salt and probably at a much higher stratigraphic horizon than we have been considering....This memo should have been written two weeks ago when the conclusions expressed above were first reached, but urgency to get on with field work precluded my getting it into a typewriter.<sup>45</sup>

However, interest persisted in considering the repository for high-level waste, causing no end of confusion among ERDA officials, Sandians, state officials, and, ultimately, the public. On February 20, 1976, Frank Baranowski, ERDA's director of Nuclear Fuel Cycle and Production, wrote to the heads of the field offices: “Further, if ALO is considering a change in the utilization of the salt bed repository to include high-level waste, commercial and/or Government, you should advise us of your plans to notify the state.”<sup>46</sup> ALO program director Delacroix Davis picked up on Baranowski's reference to a “...possible announcement of the inclusion of commercial high level waste in the WIPP” stating that, “...this is an area in which we should indeed take the initiative, and I would appreciate it if SLA [Sandia Laboratories Albuquerque] would prepare a paper regarding the technical aspects of the desirability of announcing a switch to commercial or government high-level waste at the facility.”<sup>47</sup>

Wendell Weart outlined Sandia's position to Davis, discussing the pros and cons of two alternatives on the type of waste to be placed in the WIPP. The first alternative was “To design the facility for low and intermediate level ERDA waste with the expectation that the intermediate level facility will later be modified, as necessary, to accept ERDA and commercial high level waste...by designing and constructing a low and intermediate level ERDA facility and at the same time initiating those actions with the Nuclear Regulatory Commission (NRC) which [it] perceives as requisite to licensing a high level waste facility.” The second alternative would be to design the facility for low and intermediate waste only, and carry out small-scale high-level waste experiments to obtain data but “the waste would have to be removed for permanent storage in a licensed facility elsewhere, even if the results were positive.” The report continued, “However, if it becomes evident that the licensing of a high level facility enters the critical path causing delays in the development of the ERDA low and intermediate level facility, then the high level facility should be dropped and the second alternative pursued,” adding, “...public credibility and acceptance will be enhanced by a forthright statement at the outset.”<sup>48</sup>

However, on April 12, 1976, Davis, in a somewhat chastising tone, wrote to Weart stating that ERDA Headquarters, through Dr. Carl W. Kuhlman, ERDA's director of Nuclear Fuel Cycles and Programs, had “very clearly stated the role of the WIPP...[as being] for low and intermediate waste only....high level waste will not be handled [and] the pilot plant is not being designed for commercial wastes of any kind [and it] will be designed to accommodate limited experiments with high level wastes.” Davis concluded, “Since Dr. Kuhlman was so very firm in presenting this matter, I believe it is important that all of us very carefully phrase any statements we are called on to make about the WIPP.”<sup>49</sup>



By the beginning of 1976, a “prime exploration zone” of 18,960 acres (29.6 square miles) had been identified, “...outside the potash enclave and off the known oil and gas trends, a minimum of a mile from the salt dissolution front and at least one mile from through-going drill holes.” In his letter to ERDA Headquarters, Weart concluded, “I am trying to avoid, for the moment, putting specific lines on a map [which] are associated with the words ‘site’, since we do not wish to convey to people that any further moves that might occur means site rejection.”<sup>50</sup> Eventually, the total area of the WIPP site, as identified in the Final Environmental Impact Statement (1980), remained at the same 18,960 acres or 29.6 square miles, within which the 16-square-mile prime exploration zone was situated. This area included two one-mile-wide buffer zones around the core area. The geophysical data being gathered by the Sandia scientists included not only information on the flatness of the beds and the purity of the salt, but also the nature of the ground-water system. The occurrences of ground water both above and below the salt needed to be understood in terms of their capability of dissolving the salt and of transporting the waste should it become immobilized either in a soluble form or carried in suspension. A comprehensive survey was needed of the existing natural resources of economic interest, particularly potash and hydrocarbons—a mainstay of the southeastern New Mexico economy.

By late 1976, when the repository project had been officially designated as WIPP, twenty-one potash holes had been drilled using standard industry methods for coring, assaying, and calculating the grades and volumes of reserves found there. The data obtained from these holes provided a more complete picture of the area’s potash deposits, which the information released by the potash mining companies lacked because they had not drilled in this area. Four of the holes became hydrologic observation holes. From then on, it was decided to drill all holes separately for either hydrologic or geologic information.<sup>51</sup> In addition to the three hydrologic observation holes that were drilled near the center of the site, the other four provided some data control on the southern margins of the site and brought the total number of test boreholes up to seven.<sup>52</sup> When Steve Lambert began analyzing the results of the hydrologic tests from these holes, he found profound differences between them: four orders of magnitude in hydrologic properties from east to west, lower permeabilities on the east, higher on the west. Lambert concluded after those initial studies that “...we were located in a place that did not have a conventional well-behaved ground water system such as one might have expected in this part of the country,” adding,

So the challenge became not to test the hydrologic system to see what the minimum amount of water we could get out of it was for economic purposes, but rather the maximum amount of water that we could get out. We wanted to place an upper limit on that hydrology.<sup>53</sup>

Another lesson learned from the ERDA-6 experience was that additional safety measures had to be implemented in the drilling of the subsequent boreholes. ERDA-6 had not been equipped with blowout preventers, which is standard industry practice in the hydrocarbon business, because there had been no



intention of drilling through the salt into the potential hydrocarbon-bearing beds. So every other deep borehole that Sandia subsequently drilled was equipped with hydraulic ram blowout preventers that could be closed tight in the event of fluid rushing out, such as had occurred at ERDA-6 when not only brine but toxic sour gas were released.

The Sandians kept looking for other anomalies in the area that could conceivably serve as a threat to the integrity of isolating radioactive waste. One such anomaly was called a breccia (an Italian word meaning “broken rock”) pipe. Breccia pipes are commonly found in southeastern Arizona and are associated with the big open pit copper mines in the area. They are cylindrical regions of fractured rock that at one time were permeable, meaning that fluids had once moved through them. A contractor doing geophysical surveys for WIPP performed electrical resistance soundings in the near-surface rocks, looking for accumulations of fluid in the more porous breccias because that would lessen the resistance if water were present, particularly briny water. Some features, about 1000 feet in diameter, appeared to be a little moister and formed domes on the surface from 30 to 50 feet high. One of them has a railroad cut through it so that the rock layers can be seen dipping away from the center just like a domal structure:

[The contractor] ran his soundings over some of these domal features and said, “By gosh! Some of these look like breccia pipes,” based on his southeast Arizona experience....The name stuck whether or not they were really breccia pipes formed by the same processes that occur in the copper mineralized areas of Arizona.<sup>54</sup>

There were five of these suspected domes with internal structure beneath. But it was not too long thereafter that the technical observers, like Roger Anderson of the University of New Mexico and the NRC consultants, were equating every domal feature of the same size and shape of those that had shown low resistivity with a breccia pipe. “So they produced a map of the low Delaware Basin,” recalls Lambert, “just covered with dots every one of which they assumed to be a breccia pipe.”<sup>55</sup> This suspicion by some that every domal topographic feature in the northern Delaware Basin reflected a breccia pipe coupled with lack of certainty about their consequence to a repository led to an intensive effort to better understand those domes and known breccia pipes.

Extensive geologic mapping by George Bachman and Leonard “Bud” Gard of the U.S. Geological Survey, coupled with geophysical surveys and selected borehole coring, established that only a few of these features were close to breccia pipes. Subsurface examination and surface mapping revealed a structure that provided clues to the sequence of pipe formation, which was followed by regional dissolution and subsidence around the pipe to leave it exposed as a topographic dome. Boreholes established that the breccia pipes formed below the salt in the reef carbonates where copious water was available for dissolution. All this evidence led to the conclusion that breccia pipes formed only over the reef and would not form at WIPP or provide a highly permeable path in any event.

The USGS study of shallow salt dissolution showed no threat to the WIPP site from regional dissolution. A related investigation into the potential for karst features at the site was undertaken because of obvious karst development present in Nash Draw to the west of the site. Karst is a type of topography that is formed over limestone, dolomite, or gypsum by dissolving or solution, and that is characterized by closed depressions or sinkholes, caves, and underground drainage. These studies, undertaken by George Bachman of the USGS, concluded that karst was not present at the site and would not pose a threat to the integrity of the repository over its lifetime. Nevertheless, this continued to be a controversial issue that was reviewed by the National Academy of Sciences (NAS) and by an independent panel of experts convened by the Environmental Evaluation Group (EEG), a watchdog group for the state, described below. All these groups, and eventually the Environmental Protection Agency, concluded that karst hydrogeology did not pose a threat to the WIPP site. Despite these expert opinions and the observed facts, environmental groups in opposition to the WIPP continued to invoke karst as a dire threat to WIPP even after certification by the EPA. This is one of many examples where expert judgment was not sufficient to satisfy critics, and a major investment of time and money was required to bear out the original expert opinion.

The USGS study of shallow salt dissolution showed no threat to the WIPP site from regional dissolution. The issue of the breccia pipes is important because it was emblematic of the kind of thorough scientific investigation that Sandia did to characterize geological hazards or potential geologic anomalies that might disrupt the containment integrity of the future repository.<sup>56</sup>

## **The Department of Energy Created**

ERDA itself was to be short-lived, being abolished by the Department of Energy Organization Act of 1977. On October 1, President Jimmy Carter signed legislation creating the Department of Energy (DOE) as the twelfth cabinet level department in the executive branch of the federal government. The upgrading of energy policy to cabinet-level status demonstrated the increasing concern over the nation's energy needs ever since the Ford administration. President Ford had declared energy to be a "top priority" for his administration and cited the need for a "national energy plan."<sup>57</sup> True, the principal energy concern for both the Ford and Carter administrations focused on the nation's dependence on unreliable foreign suppliers for its oil supply. And events such as the Arab oil embargo in 1973 had repercussions on waste policy, as when AEC chairman Dixy Lee Ray refused to set aside Los Medanos for the proposed repository because it would have meant stopping oil exploration in the area. Among ERDA's accomplishments during its brief three years of existence was the reorganizing and streamlining of administration "...so that at long last both civilian and defense waste management were under one roof."<sup>58</sup> ERDA, carried over in its entirety, formed the major part of the new DOE. The civilian waste program focused its technical studies in the Office of Nuclear Waste Investigations (ONWI) at Oak Ridge National Laboratory.

Regarding waste management, Congress, in its organization act, was “quite specific in delineating DOE’s responsibilities....to establish control over all existing nuclear waste owned or held by the Federal Government and all commercial nuclear waste presently stored on other than the site of a licensed nuclear power electric generating facility.” The act also directed DOE to “establish programs and facilities for the treatment, management, storage, and disposal of nuclear wastes.”<sup>59</sup>

## Controversies between DOE and New Mexico

Still, uncertainty persisted over WIPP’s ultimate mission. Carter’s newly appointed Secretary of Energy James Schlesinger reopened the controversy in 1977 by suggesting that the scope of WIPP be expanded to include possible handling of high-level waste. In a letter to New Mexico’s congressional delegation dated November 29, 1977, George W. Cunningham, DOE’s acting program director for nuclear energy, assured them that no decision had been made to expand the scope of WIPP to include possible handling of high-level waste. Cunningham continued, “We are, however, seriously considering seeking a license from the Nuclear Regulatory Commission (NRC)...to keep open the option of future placement of high-level waste from the defense program there.” In a letter dated November 25, four days prior to the letters sent to New Mexico’s congressional delegation, Cunningham stated that “DOE is proceeding with plans to license the WIPP site as a high-level facility, though a decision on whether to actually ship high-level waste for disposal would not be made until at least 1979....At this time the Dept. of Energy would like to state formally that we intend to expand the scope of the WIPP design to include the capability for the potential disposal of high-level defense waste.”

New Mexico Senator Pete Domenici said that he did not believe the DOE had been “candid” about its intentions for the proposed WIPP site, criticizing the agency for an “apparent” contradiction between the two letters.<sup>60</sup> New Mexico’s other senator, former astronaut and moonwalker Harrison Schmitt, wrote to Schlesinger suggesting that he meet with the New Mexico congressional delegation before any decisions were made on WIPP, emphasizing that “Direct and complete communication between the people of New Mexico, their congressional delegation and Secretary Schlesinger is of the utmost importance during this decision-making period....We must have an open line.”<sup>61</sup> In a report to Congress titled “Nuclear Energy’s Dilemma: Disposing of Hazardous Radioactive Waste Safely,” the U.S. General Accounting Office reported that “state officials and the general public in New Mexico are leaning in support of a waste disposal site in the southeastern corner of the state,” according to a document “from officials in New Mexico.” But an *Albuquerque Journal* reporter identified the “document” as a letter sent to ERDA headquarters the previous year in 1976 by New Mexico’s Interim Legislative Energy Committee, which was disbanded in early 1977 when its funding was discontinued. The letter, “prepared without Governor Jerry Apodaca’s knowledge...was an open plea to bring any and all nuclear facilities to New Mexico, including waste

disposal.” Even though the governor “disavowed knowledge or support” for the letter, “ERDA has been brandishing [it] as proof of the acquiescence of the people in New Mexico to the federal government’s waste disposal plans.”<sup>62</sup>

The conflicting signals, or “zig zagging,” in Robert Statler’s (the Sandian in charge of drilling operations at the WIPP site) words, on WIPP’s mission seemed to originate in the priority task force formed by DOE to assess current nuclear waste management programs, as ERDA had three years earlier. The task force completed its report in February 1978 which among its conclusions stated that further research and development in bedded salt and technical demonstration of the emplacement of spent fuel in a monitored facility was “vitally needed.” The task force report observed that the WIPP site would meet these requirements, but current planning limited it to defense wastes. It thus recommended that “WIPP be used for civilian waste research and development and demonstration as well. A moderate-scale demonstration of spent-fuel emplacement at WIPP would require licensing and regulation by the NRC....[and] legislation to permit land withdrawal would be needed to allow departmental use of WIPP.”<sup>63</sup>

While support for WIPP was still primarily concentrated in the Carlsbad area, the public controversy over the commercial waste issue, prominently discussed in the state’s major newspapers, the *Albuquerque Journal*, the *Albuquerque Tribune*, and the *Santa Fe New Mexican*, helped to galvanize public awareness of WIPP issues, especially in Albuquerque, Santa Fe, and Taos. In Carlsbad and surrounding Eddy County, the WIPP project enjoyed strong support from political and business leaders. For these leaders, “the backyard in question was a windblown, semi-arid plain of scrub brush and red sands twenty-five miles to the east of Carlsbad....The soils were poor and there was no prolific aquifer to irrigate them.”<sup>64</sup> Carlsbad, as described previously, was a town “energetic in self-promotion,”<sup>65</sup> as evidenced by the turn-of-the-century renaming of itself to exploit the area’s mineral waters. With the discovery of rich potash reserves, Carlsbad by the 1930s had transformed itself into a mining town. In 1930, with the opening of Carlsbad Caverns as a national park, the local economy received another boost with tourism. Prominent WIPP promoter and Carlsbad Mayor (1970–1986) Walter Gerrells told the story best:

Up through the Fifties, we had a virtual monopoly in the Western Hemisphere on potash....But we woke up here one morning in 1967, October 13, and U.S. Potash, the largest employer in Carlsbad, announced that as of the first of the year, it would cease operation....The result, by Post Office count was 1250 empty houses in Carlsbad in 1969. Our population by the 1970 census was 21,297 [down 5000 residents in ten years]....So some potash officials and some officials of the AEC came here in 1972. We met with them. We had lunch with them. Senator Gant, our state Senator, was there, plus myself, the county commissioners and others, and the AEC laid it right on the table. “We’ve been up at Lyons [Kansas], we’ve had some problems there, we want to look at salt beds in southeastern New Mexico, what we’re trying to do is find a safe place to isolate low-level nuclear wastes.” So right then, we went to Santa Fe and met with Governor Bruce King and we adopted more or less a policy, if you want to call it that. It’s still our same basic policy today [1979]: As long as the studies done by the scientific world, the environmental-impact statements, all the other data indicate no harm to the environment or the people, we’ll support the project. That’s the way we felt then, that’s where we are now.<sup>66</sup>

## The Veto Controversy and Public Involvement

WIPP was beginning to attract increased public attention and controversy. In spite of the strong local support in Carlsbad, “There’ve been places in [New Mexico] when things were not looked upon with as much favor,”<sup>67</sup> in Weart’s understated observation. There was, for instance, the issue of New Mexico’s veto power. When the New Mexico congressional delegation met with Schlesinger on February 2, 1978, they were apparently promised a veto over WIPP and any other federal repository projects. The energy secretary “...said unequivocally that the federal government will not build a nuclear waste disposal pilot project in New Mexico without the approval of the state government.”<sup>68</sup> Schlesinger’s deputy secretary, Jack O’Leary, later said that making such concessions to New Mexico and other states simply amounted to a recognition that a repository cannot be built over determined host-state opposition.<sup>69</sup> But many in New Mexico at the time interpreted Schlesinger’s offer as amounting to a veto, the constitutionality of which was murky. The Washington bureau chief of the *Albuquerque Journal*, Paul R. Wieck, took DOE to task:

Now it should be stated that no one at DOE has said New Mexico won’t have the right to turn down WIPP if it wants to; however, there’s something disconcerting about the semantics being used. At DOE, they talk about New Mexico’s “right of concurrence.” They go on to talk, in very vague terms, about how it’s important that DOE and state officials need to get together and set up the procedures by which the state will exercise the right of concurrence. Somehow, it doesn’t sound like a flat right to veto when the DOE boys are talking about it.<sup>70</sup>

Further controversy surged when O’Leary, who had been Governor Apodaca’s energy chief before moving on to DOE, favored the Deutch report in March 1978 which recommended putting 1000 spent fuel assemblies in WIPP as a demonstration that it was safe to store them in salt beds. This report resulted from a task force headed by Director of Energy Research John Deutch, which was formed to review nuclear waste programs. The Deutch report also recommended committing the military transuranic waste to WIPP without provision for retrieval, the reasoning being that since such waste generates little heat, no observable interactions would occur between the waste and the host rock even if a period of retrievability were provided.<sup>71</sup>

The DOE held a series of meetings to solicit public comments on the Deutch Report and specifically to gauge reaction to the proposal to locate a nuclear disposal site in New Mexico. At a series of, at times, acrimonious public hearings held over three days during April 1978 in Carlsbad, Albuquerque, and Santa Fe, over 1500 persons turned out to “...simply listen or to present the visiting panel of high-ranking DOE officials with their fears, their facts and their frustrations regarding nuclear power.”<sup>72</sup> Jack O’Leary articulated the DOE position at each meeting which was that “...nuclear power can and should continue as a major energy source at least until the time when more benign energy technologies can be brought on line...[and that the Deutch report] prepared over a three-month period

[was] an attempt to bring order to the 'chaos' which has characterized nuclear waste management over the past thirty years." O'Leary reiterated during the hearings that the proposed WIPP facility was "vitally important to the emerging nuclear strategy of the Carter administration." Witnesses ran the gamut from potash miners, most of whom supported WIPP but one of whom charged that the waste disposal project "...would eliminate some 49 million tons of potash valued at \$1 billion....My future and many like me depends on the potash industry near Carlsbad" to one Sandia scientist who, speaking in his own behalf and not for Sandia, dismissed the concerns over radioactive waste as "mythology and superstitious fear." One witness, in an impassioned plea, said he could not abide by the plan to place "radioactive poison into Mother Earth." If legal avenues fail[ed] to stop the project "...then we must physically place ourselves between this and the land we love. We will stand there in objection—we will be buried there if necessary."<sup>73</sup>

Meanwhile the veto controversy did not abate. DOE continued to assure New Mexicans that WIPP would not be built if the state objected, but the U.S. Comptroller General and the DOE general counsel took the position that these assurances were not legally binding. Toney Anaya, New Mexico's Attorney General, senatorial candidate, and future governor (1983-1986), insisted that Congress should give New Mexico an explicit legal right of veto and called for an "immediate moratorium" on further expenditure of federal funds for the repository until the required EIS was completed.<sup>74</sup> Senator Domenici, meanwhile, was seeking such a right for all repository host states, but not getting much support from his colleagues in the Senate. New Mexico, in demanding a veto, was saying it wanted at least enough control over WIPP to prevent unexpected and undesirable changes in the project mission. State officials also wanted to make sure the repository would be safe and that the state would be compensated for any new burdens associated with WIPP. The Deutch report "had pointed up the state's lack of control, putting WIPP at risk by challenging state officials to take action."<sup>75</sup>

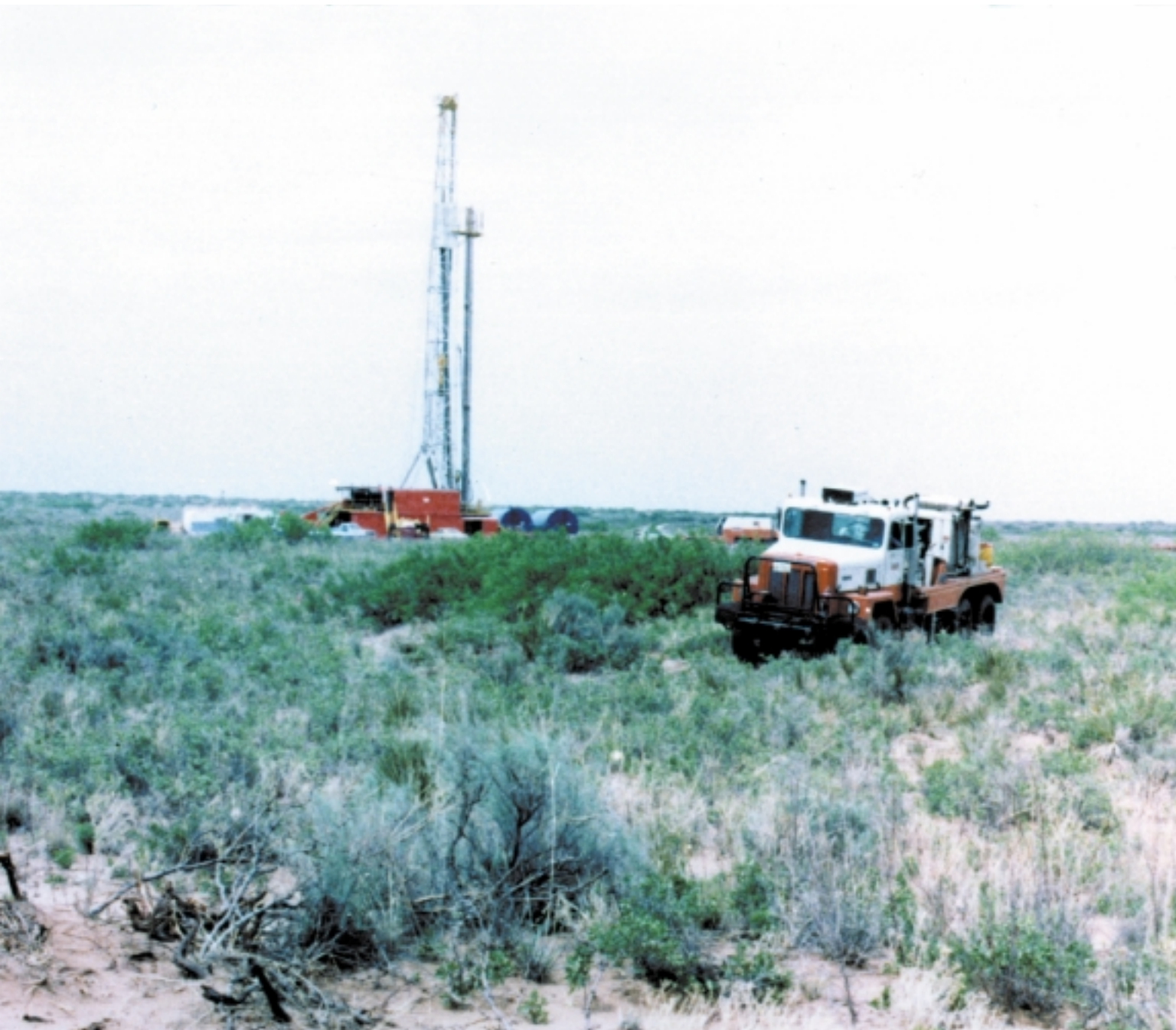
Another complication, if more were needed, in the controversy over WIPP was that the proposals advanced by Schlesinger, Cunningham, and the Deutsch report to test commercial waste in the repository, which would require NRC licensing, had angered the House Armed Services Committee. WIPP had originally been conceived for military transuranic waste, making it a disposal facility that did not need licensing by any civilian federal agency. The House Armed Services Committee banned the use of any of WIPP's \$40 million for the purpose of seeking a license for the facility or storing spent fuel rods. Representative Manuel Lujan of New Mexico supported this action because he favored reprocessing spent fuel rods, while Representative Harold Runnels of New Mexico favored NRC licensing because he knew that "New Mexicans [wouldn't] have a thing to say about WIPP if the Pentagon [got] its way, and that the only way for them to have any input [was] through a licensing process."<sup>76</sup>

As a conciliatory measure, DOE funded the Environmental Evaluation Group (EEG) in late 1978, a state agency charged with measuring the risks associated with the proposed WIPP. EEG was the successor to the GTEC Subcommittee, the group of part-time volunteers formed by Governor Bruce King in 1973. They had not been able to devote the necessary time or attention to evaluating WIPP. New Jersey native Robert Neill was appointed EEG's director. He was formerly associate director of the U.S. Bureau of Radiological Health. Neill has continued in the EEG position through the present (1999). Neill doubted that his group would be subject to political pressure because of the scientific nature of the EEG's review. It did not have to decide whether WIPP should be built and it would not be looking at employment or emotional issues associated with the facility. "The group will simply quantify the risks associated with WIPP," he said. "That report will go to the state Health and Environment Department, the Legislature, the governor, and eventually the people."<sup>77</sup> The EEG's creation was important because it "contributed to defining WIPP as an issue that [could] be dealt with on its technical as well as its political merits."<sup>78</sup>

In late 1979 Congress passed the WIPP Authorization Act which blocked both DOE's initiative to include a spent-fuel disposal demonstration at the site and President Carter's initiative to cancel the project. The legislation gave the state of New Mexico a "considerable voice" in the project, although not a right of veto. It did direct that DOE and New Mexico negotiate a "consultation and cooperation" agreement that would put DOE in a position where it had to "give great weight" to the state's demands.<sup>79</sup> This provision did not mean that the "C and C agreement" would be arrived at soon; negotiations and outright bickering would continue between DOE and state officials until 1981 when the contract was finalized (albeit amended in 1985 and 1988), pushed by Attorney General Jeff Bingaman's lawsuit.

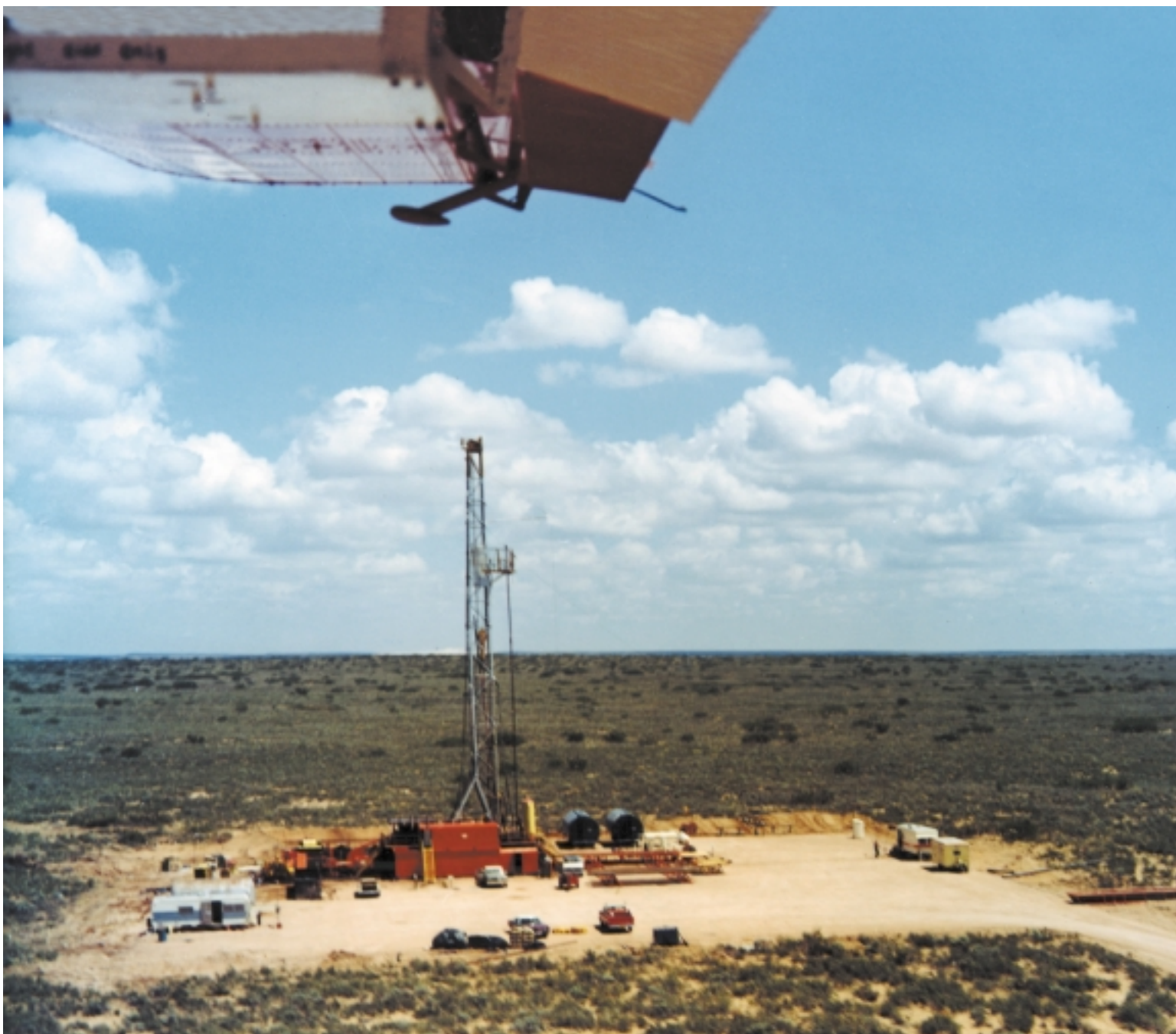
## The Final Site Selection

During mid to late 1975, Sandia forged ahead with its search for a suitable site for the proposed WIPP repository. George Griswold, still smarting from the "downgrading" of WIPP from a commercial waste repository to a "warehouse" for military transuranic waste, intensely turned his efforts to the drilling of ERDA-9. Working with Sandian Robert Statler and Earl Cunningham (a Fenix and Scisson contractor who provided drilling management services), Griswold was instrumental in the selection of the ERDA-9 site. Drilling began on April 28, 1976, on the second proposed site some six miles south/southwest of ERDA-6, and was completed on June 4, less than one year after ERDA-6 was started. The criterion was that the hole be at least two miles from oil and gas wells.<sup>80</sup> The dry language of a technical report described the results: "Confirmed satisfactory stratigraphy, lithology, and mineralogy. Drill stem tests showed no significant amount of fluid within the Salado. Hole bottomed 50 ft into the Castile Formation in Anhydrite III. Hole completed in Anhydrite III of Castile Formation."<sup>81</sup> Weart communicated the good news to Delacroix Davis in a memo dated June 21, 1976, as follows:



*ERDA-9, Sandia's first exploratory borehole at the present location, drilled into Castile Formation near the center of the new site around April 1976.*





*An aerial view of ERDA-9 in the spring of 1976.*

On the basis of the geological and geophysical work completed to this point, the area currently under investigation for the Waste Isolation Pilot Plant (WIPP) meets existing site selection criteria and is acceptable for the next stage of site development. In order to protect this site from potentially detrimental activities by outside interests, we are requesting that ERDA/ALO initiate land withdrawal actions as soon as possible.<sup>82</sup>

In other words, the salt beds were at the proper depth and level—the perfect conditions to drill a shaft from which to initiate the excavation of the future underground experimental and storage facilities. As Les Hill commented: “[It] came out very well, like a textbook case. ERDA-9 was George’s finest hour.”<sup>83</sup>

It must not be overlooked that the final site selection was accomplished in the face of many physical and mental difficulties not least of which was the long drive from Carlsbad to Los Medanos on Refinery Road, a two-lane highway dubbed Dead Cow Road by parties unknown,<sup>84</sup> which was frequented by cattle and their occasionally antagonistic owners. One rancher complained that “...people have been driving too fast and, consequently, running a high risk of hitting cattle.” Weart’s cautionary memo continued:

The killing of a cow while driving an auto is almost impossible to hide and therefore if any Sandian or an associate of Sandia’s WIPP project had done so, it most likely could not have escaped our attention. We are not aware of any such incidents involving WIPP personnel, but we are aware that some of our staff have been cited for speeding in the area. Please caution your personnel and associates against speeding in the open range areas. The price of beef is higher “on the road” than in the market.<sup>85</sup>



*Martin Molecke took this photograph in 1988 of a cow struck and killed by a speeding motorist on Refinery Road, the highway leading to the WIPP site. An unknown prankster spray-painted the Westinghouse logo on the carcass.*

Some of the studies at this time were concerned with subsidence, or settling, that can occur above facilities that are mined in salt. This can be due to the deformation of the salt which eventually closes in on the underground openings and that closure translates itself as a surface subsidence. The potash mines were an area where this could be studied, so a Sandia crew, which included Bill Vollendorf and Sam Baker, was out looking at subsidence-caused surface cracks. Weart described what happened next:

...we had a little airplane that was doing some aerial photography for us and in order to provide them directions, they would swoop down low and Bill was out there in the field waving his arms, trying to give [the airplane] directions. Well, here we are miles out from nowhere, nothing

around, obviously interacting with this little flying airplane which was circling around and the Highway Patrol comes by, sees a strange behavior going on, and I guess they thought it was a marijuana drop or something.. So [the police] actually were about to arrest these two Sandians [who] tried to explain what [they] were doing [which] made absolutely no sense...at all [to the officers].<sup>86</sup>

When Vollendorf and Baker explained that they worked for Sandia, the officers had no idea who or what Sandia was. The situation got rather ticklish before the officers were persuaded to contact some authorities to establish that the field activities with the airplane were legitimate and not some kind of drug drop.

## **The Asse Facility in Germany**

Foreign waste disposal experimental projects also attracted the attention of American scientists in the late 1970s, among them Sandians working on WIPP. One of these was the Asse salt mine in northern Germany about five miles west of the East German border. The facility had been in use since 1967 for detailed experiments related to disposal of radioactive wastes, in this case low-level and intermediate-level waste from the Karlsruhe and Juelich nuclear research centers. A significant difference between the Asse facility and projected American repositories was that the German salt mine was not originally built as a radioactive waste repository but was adapted to that purpose. It opened as a commercial mine in 1908, producing rock salt and potash; commercial operations ended in 1964.

Alan Sattler, a Sandia employee assigned to the WIPP project, went to Germany in 1978 for an extended stay at the Asse facility “to see what the West Germans were doing and learn how they do things, and he gained a great deal of valuable experience which was later applied to WIPP.”<sup>87</sup>

## **Environmental Studies and Conceptual Design**

Concurrently with the search for a new site, Sandia, as mentioned above, was also pursuing other activities such as developing the biological, ecological, and cultural information necessary to prepare the first Environmental Impact Statement (EIS), a draft of which was due by October 1, 1976.<sup>88</sup> A preliminary study that provided a base for the draft EIS was the Technical Alternatives Document (TAD). TAD's full title was “Alternatives for Managing Wastes from Reactors and Post-Fission Operations in the LWR [light-water reactor] Fuel Cycle”; prepared by “some 200 waste management experts at Laboratories in the U.S....TAD was a complete reference work on the status of technology as of September 1, 1975 for managing radioactive wastes [generated] from the back end of the commercial LWR fuel cycle.”<sup>89</sup>

At the time of the drilling of ERDA-6 in 1975, Sandia's geological, seismic, and hydrological investigations were already underway. Mel Merritt initiated biological

and meteorological work for the preparation of the EIS required by the National Environmental Policy Act (NEPA).

The region surrounding the Los Medanos site had been under study for many years before the WIPP project was proposed, especially for the GNOME underground nuclear test in 1961. The US Geological Survey had studied it intensively because of its oil and potash resources. Sandia's biological studies began in 1975, meteorological studies in 1976, and economic studies in 1977, all under Merritt's overall direction. Working with him were Pat Brannen and Sieglinde Neuhauser. Brannen was in charge of the biological studies that Neuhauser took over later on. Brannen's guiding principle in biological work was, in his words: "We must leave footsteps that people can easily trace 50 years from now or anytime in the future." He described some of the pitfalls inherent in the work when outside groups were looking over your shoulder: "If you were in something like I was—the safety analysis—you had to eventually get around to what the biological effects were but you couldn't get there without going through the geology [and] any one of those groups could stop you dead in your tracks because you didn't do that right."<sup>90</sup>

Sieglinde Neuhauser described an experience that arose from responding to concerns about possible environmental effects of the WIPP repository:

An original survey was done on flora and fauna, and it noticed that the Carlsbad Cavern bat was the long-tailed Mexican bat. Carlsbad Caverns was on the edge of the range of the bat, the nightly maximum distance that bats can travel and come back in the morning. Therefore, there was no problem—that was how it was originally written. And some people decided to make an issue out of it. If there were some kind of release at the site, the bats could get contaminated and it would be terrible for the bats and the tourist industry. [So we had to] go back and take a second look at it. Ten thousand dollars was allocated and we paid a student to sit there....He caught three Mexican long-tail bats that summer. That was \$3,333 a bat—it was a giant waste of the summer. It was the beginning of a trend toward questioning technical results that nobody, really, who is reasonable, could question except for political reasons.<sup>91</sup>

In April 1977, Merritt, Felton Bingham, and Don Matejka produced their first draft EIS, or DEIS. It was "promptly rejected," in Merritt's words:

...mainly because of our description of the WIPP mission....There had been no written mission and what we described was a facility where we would try out in the real world the principles and practice of storing TRU waste in bedded salt. It would be a pilot plant—limited quantities, realistic rates of storage, all retrievable. It would be operated for 5-10 years, with extensive instrumentation and experiments, investigating the validity and long-term safety of all this. At the end of the pilot plant stage, a formal determination would be made through the NEPA process (including a new EIS) of whether it was proper to convert to a TRU (and HLW) repository. Don Vieth, whom I came to like very much because of his openness and unpretentiousness, explained that the primary (first) audience for a DEIS was Congress and we just couldn't go to them and say we had a half-billion dollar experiment to propose—even if this presentation would go over a lot better in [New Mexico]. We should rather take the positive attitude that the ERDA (then) intended to build a repository, being cautious in starting, pilot plant = initial limited, retrievable operations period.<sup>92</sup>

Donald Vieth was chief of the Waste Repositories Branch at DOE Headquarters and in May of 1978 he “upbraided” ALO (Albuquerque Operations Office) for “expressing doubt about the safety of the proposed nuclear waste repository at Carlsbad.” In a memo evidently not intended for public dissemination but obtained by Southwest Research and Information Center, an anti-WIPP organization in Albuquerque, Vieth criticized the DEIS and “demanded” revisions before it went any further up the line. Among the statements he objected to were that “some of the descriptions of the project leave the impression that we know very little about safely isolating non-heat producing nuclear waste in a deep geologic formation [and that DOE was undertaking]....an experimental program that will run in excess of 10 years at a \$50 million per year level to confirm our belief that we can safely handle radioactive waste....Such an impression in an environmental impact statement would repudiate all that has been said about our previous research.”<sup>93</sup>

The problem reflected by Vieth’s memo was that between 1976 and 1979, the mission of WIPP was constantly being changed. As noted above, first ERDA and then DOE officials often ascribed different uses for the “pilot plant”—at times it was to be for transuranic waste only, at others it was to be considered for spent fuel from commercial nuclear power plants. With each of these contradictory statements, public confusion and controversy grew. And none of this made the writing of the EIS any easier.

Felton Bingham, second member of the EIS team, joined Sandia in 1964 and transferred to WIPP in 1976. Regarding the EIS, Bingham recollected in 1996 “how naïve we were, how little we understood, the redeeming feature [was] that nobody else in the world understood either.” He marveled that at the time it was thought that an EIS could be written by only three people: “Nowadays, EISs run thousands and thousands of pages, with many, many primary authors and even larger numbers of reviewers, and an equal number of quality assurance people.” He summed up the frustrations of the early EIS process:

Even before we produced that early draft which we called the PDEIS—Preliminary Draft Environmental Impact Statement, we called it that partly because it wasn’t really an EIS and we kept insisting it cannot be one until at least the DOE has had something to say about it. But a little while before that, shortly after I joined the group, we had a deadline facing us to write an EIS and it was on a time scale of two or three months. And one day I realized, we’ve got to get this thing done and Mel was out of town. So I sat down and just started writing....When Mel got back we talked to a man named Baranowski, and somebody had explained to him that an EIS is not just a few pages....So we got out from under that deadline. People were still trying to learn what an EIS means. There were still people...advising us at that time that when people like Senator Jackson wrote the National Environmental Policy Act, what they were thinking about in this impact statement was about a dozen pages or so. Let’s make sure that someone has looked at the effects on the environment and then decided that it’s not really going to be a disaster....And during the time we were writing this, the nation’s notion of what such a statement should be was going to change a lot....during the time we were writing this thing, the rules for what it should be were changing, and one of the interesting challenges we had, second only to the challenge of what on earth is the mission of the WIPP, that caused us an awful lot of very late

nights, was trying to write and revise and redo the document so it could cope with the changing notions of what NEPA required and the changing notion of what the WIPP [was] supposed to be.... And I remember feeling awfully indignant in my naïve arrogance, that people who were telling me we had the wrong mission for the WIPP didn't know what they were talking about. What I didn't understand of course was that nobody knew what the WIPP was supposed to be, but I thought what we had written down had to be the truth.<sup>94</sup>

When the WIPP Authorization Act was passed in 1979, the consideration of WIPP for commercial waste was once and for all eliminated. The site was then assigned a definitive mission, which is what the EIS project needed in 1978. DOE also had to be convinced that the three Sandians who were writing the PDEIS—Merritt, Bingham, and Matejka—needed a lot more help in the form of specialized contractors and production assistance.

In May 1978 Merritt, Bingham, and Matejka completed the PDEIS and got extensive comments back from within Sandia. Another draft in September 1978 was extensively reviewed, especially by Westinghouse which DOE had chosen to be the technical support contractor for WIPP. This meant that Westinghouse would provide an independent assessment of Bechtel, Inc. of San Francisco, which was designing the facility and whose contract would run through the end of the 1979 fiscal year in September. Bechtel was hired as WIPP's architect early in 1978.<sup>95</sup> A fourth draft was produced on October 2, 1978, comments on which "were by and large mild," according to Merritt. With a draft almost ready to go into production in late 1978 that included TRU waste, high-level waste experiments, and a demonstration with 1000 spent fuel canisters, Merritt learned that, in response to recommendations from the Interagency Review Group, a special federal task force, some DOE officials wanted to remove spent fuel from the main mission and have it treated as an alternative. This was on November 12 and the EIS was due to go into production on December 1. There was a flurry of contradictory instructions from DOE officials about the proposed change, which Jack O'Leary had to bless. Merritt recalled that "O'Leary had originally set the end-of-the-year time for the document, that required Dec[ember] 1 from us, and had made this a very public promise....So since we had plenty to do anyway, I didn't want any such changes made until we had a confirmation that O'Leary had OK'd the change and the delay." At a meeting on November 17 with O'Leary no one had brought up the proposed change or the delay. Merritt asked a DOE official who had been at the meeting if "everyone was afraid to talk to O'Leary, and he said yes, everyone, including Deutch."<sup>96</sup>

In August 1978, Sandia produced a Geological Characterization Report (GCR) which presented, in one document, a compilation of geologic information available up to that date which the authors judged was relevant to WIPP studies. The GCR contained the caveat that it should not be construed as the "final word" on the WIPP geology. Furthermore, it stated that it is "neither a Preliminary Safety Analysis Report nor an Environmental Impact Statement....[the GCR] is a unique document and at this time is not required by regulatory process."<sup>97</sup>





*Looking over their just-published Geological Characterization Report for the WIPP site in 1978 are (left to right) Les Hill, Steven Lambert, Dennis Powers, and Sue-Ellen Shaffer.*

The delayed DEIS was finally released in April 1979 in two volumes, each more than an inch thick. At a news conference, ALO's WIPP project manager Don Schueler, in announcing the report, indicated that the underground salt beds 30 miles east of Carlsbad "would be suitable for nuclear waste storage....We have never said it is the most perfect or only site in the nation." He added, "WIPP is the only site now available." The report concluded that if a nuclear waste facility were located at WIPP, the environmental impact would be "insignificant." Schueler added that the purpose of the environmental statement on WIPP was to "provide the public with enough information in layman's language to assist them in making a decision regarding the plant."<sup>98</sup> The demonstration, or analysis of the effects, of spent-fuel rods at the WIPP, which had remained in the DEIS as an option, was opposed by New Mexico Representative Manuel Lujan who said he would support the WIPP with the third option—WIPP without spent-fuel rods.<sup>99</sup>

The first public hearings on the draft statement were held on June 7-8 in Albuquerque's Convention Center. Both pro and anti-WIPP groups showed up, posted signs, and sold T-shirts and buttons. Many who went to discuss the DEIS expressed dismay at the short time allowed for review of the voluminous material provided by DOE. Robert Neill, head of EEG, told the DOE panel that because of the lack of time, he could not comment on the impact statement but could only describe the work his group was doing to check data provided in the document.<sup>100</sup> However, by August 1979, EEG issued a 75-page report evaluating that document.<sup>101</sup>

The DEIS did elicit some "glowing remarks," proffered by General E.C. Hardin, after whom a street and a park are named on Kirtland Air Force Base. In a message to Sandia President Morgan Sparks, Hardin declared:

The world will soon forget that serious discussions were held in Idaho, and New Mexico on the WIPP DEIS, but the emotional implications will linger on. Regardless, I want you to know that the one thing that gave us the strength to pick our way through the charges and counter charges was the thorough work done by Sandia on the DEIS itself. This effort at an untold cost in labor and frustration has resulted in a document that represents the best example of objective and sensitive care in decision making that I've seen in 38 years of government service. Please make Mel Merritt and his people aware that this part of DOE will never forget their impressive contribution.<sup>102</sup>

The other major activity that Sandia was pursuing concurrently with site selection and EIS development was the establishment of the quantities and characteristics of the waste to be disposed of, the operating requirements, and a credible conceptual design, cost, and construction schedule. As discussed previously, considerable uncertainty existed as to the type of waste and final mission of the repository. This effort was assigned to Leo Scully, who had joined Sandia in 1960. Between then and the initiation of the WIPP design effort, he had been involved in the design, development, and fielding of equipment for field-testing operations at Tonopah Test Range and other remote operations and for full-scale nuclear effects testing at the Nevada Test Site. During these activities Scully became familiar with operating facilities in remote sites and the handling of hazardous and nuclear materials. He



assembled a multi-disciplinary team of highly skilled Sandia engineers and specialty contractors in the spring of 1975 to accomplish the design.

One of the first tasks was to define the waste to be accepted at the facility. Paul O'Brien, a senior nuclear engineer, was assigned this supposedly straightforward task. When Scully asked O'Brien his approach, the latter responded, "I'm going to take about six months and characterize and inventory all the waste and then I'll find another job." Scully observed that this was in 1975, and "I don't believe the waste is completely characterized to this day [1997]." He, O'Brien, and Bob Stinebaugh toured each of the DOE sites around the country to learn what kind of waste they had, what was stored "out in the back 40—we found they didn't have a good record of what they had," recalled Scully, "they had lots of stuff but didn't know what it was or where it all came from. Even with all the characterization efforts in the intervening years this is still somewhat true today [mid 1990s]."<sup>103</sup>

In spite of the uncertainties in waste characterization, sufficient data were assembled to allow a credible conceptual design effort to proceed. The major segments of the conceptual design were the waste-handling process and the necessary equipment, the supporting surface facilities, the underground storage facilities, and the infrastructure to support a major new operation in a remote area, e.g. roads, rail, power, communications, water, sanitation. Principal contractors supporting the conceptual work were Fenix and Scisson for underground engineering and Holmes and Narver for surface facilities.

Complete sets of equipment were designed for handling and emplacing both high-heat-producing waste and contact-handled TRU waste. For heat-producing waste, design of the equipment necessary to prepare an emplacement position was also developed, including retrieving and overcoring equipment. For the contact-handled waste, handling and packaging equipment was not only conceptually designed, but also developed, tested, and the concepts proven to be satisfactory.

The conceptual design for the facilities was completed in 1977. According to Scully, "the original conceptual design was initiated and finished not knowing if WIPP was going to be solely transuranic or also a high-level waste facility. Consequently we designed a two-level facility, with the lower 2700-foot level for heat-producing waste. After the report was published and the decision made not to put high-level waste there, a brief reconfiguration study was conducted to convert to a single-level facility."<sup>104</sup>

In addition to the engineers, the conceptual design effort used the expertise of the Sandia rock mechanics and experimental laboratories to obtain rock design properties as well as the analytic groups for finite element design analysis. The complete conceptual effort probably utilized the efforts of between 30 and 40 engineers and scientists in addition to a like number of contracted support services.

Follow-on Sandia design activities supported the DOE Project Office in the selection of the Bechtel team for the Title I effort. The Sandia engineers also provided technical expertise in guiding and providing technical oversight to the Title I design prior to closing out the WIPP engineering efforts in 1979.<sup>105</sup>

In the late 1970s, after Sandia had an opportunity to assess the state of TRU wastes at the various generator sites, it concluded that WIPP's design job would be much easier and safety more easily assured if the wastes could be incinerated and processed at the sites of origin before being shipped to the WIPP. This was proposed to a large meeting held in Albuquerque where all the generators were represented. INEL was represented by Leo Duffy, who was manager of their waste programs. He was most incensed to have Sandia suggest they should spend millions of dollars to address what in his view was a non-problem. This waste, after all, was regarded as innocuous material posing very little hazard. Wendell Weart felt lucky not to have Sandia be "tarred and feathered" by the generator representatives by the time the meeting concluded. Ironically, years later when Duffy became the Assistant Secretary for Environmental Management in the DOE, one of the programs he sponsored for INEL was the processing of buried transuranic wastes—an example of how circumstances can change over the lifetime of a project lasting as long as the WIPP.<sup>106</sup>

By 1979, five years after being chosen by ERDA to assume the geological studies at the Los Medanos site, Sandia had identified an area suitable for future mining operations, completed a draft environmental impact report that was being debated in public meetings in New Mexico, and completed a conceptual design of the surface and underground facilities for the future site. Sandia accomplished all these tasks while uncertainty and controversy prevailed first in ERDA and then DOE on what type of waste should be stored in the repository. This coincided with increasing public concern over nuclear energy and the disposal of radioactive waste, and the active opposition of various environmental and anti-nuclear organizations. In the ensuing years, there would be slow progress toward actual construction of the facility in the midst of continuing public controversy.

## Notes

1. Carl J. Mora, "Bridging the Cold War and the Twenty-First Century: Chronicling the History of Sandia National Laboratories," *Journal of Government Information*, vol. 25, no. 4 (1998): 322.
2. Quoted in Necah Stewart Furman, *Sandia National Laboratories: The Postwar Decade* (Albuquerque, NM: University of New Mexico Press, 1990), p. 119.
3. Kimball Prince, "Sandia Corporation, History of Formation," manuscript, June 1960, Sandia Corporate Archives (SCA), p. 2.
4. Letter, David E. Lilienthal to Leroy Wilson, June 24, 1949, in *ibid*.
5. Mora, "Bridging the Cold War and the Twenty-First Century," p. 323.
6. See Robert W. Henderson's eyewitness description in Leland Johnson, *Sandia National Laboratories: A History of Exceptional Service in the National Interest*, SAND97-1029 (Albuquerque, NM: Sandia National Laboratories, 1997), pp. 16-17.
7. John R. Banister, *Historical Sketches of Sandia National Laboratories Nuclear Field Testing*, vol., SAND93-7054/1 (Albuquerque, NM: Sandia National Laboratories, 1994), p. 1.
8. See Leland Johnson, *Tonopah Test Range: Outpost of Sandia National Laboratories*, SAND96-0375 (Albuquerque, NM: Sandia National Laboratories, 1996).
9. "Biography of a Sandia Senior Fellow," Sandia National Laboratories website, <http://ntp.sandia.gov/NWMP/wwwwebpg/wwwwebpg.htm>, WIPP Collection (WC), SCA.
10. Wendell Weart, interview, May 28, 1996, p. 1, Oral History Collection (OHC), SCA.
11. Wendell Weart, E-mail, November 6, 1997; Morgan Sparks to Wendell Weart, August 29, 1973, WC, SCA.
12. Les Hill, "Background on the Waste Isolation Pilot Plant (WIPP): History-Objectives-Accomplishments-Status," p. 4, submitted by Delacroix Davis, Jr., Director, Nuclear Materials and Waste Management Division to Donald Vieth, Chief, Waste Repository Branch, April 21, 1977, WC, SCA.
13. "Early Decisions/Project Acceptance for the Waste Isolation Pilot Plant," videotaped interview with Albert W. Snyder and Tom Hunter, December 17, 1996, SAND96-2840, WC, SCA. These are Snyder's recollections as recounted to him by Morgan Sparks.
14. Snyder's account from memory. *Ibid*.
15. *Ibid*.
16. *Ibid*.
17. William P. Armstrong to Wayne Knowles, July 16, 1975, Book One—Correspondence, May 14, 1975 thru June 30, 1976, Sandia Laboratories R.W.P.P., binder 102, Inactive Record Transfer (IRT) box/index no. 123291, Sandia WIPP Central Files (SWCF). Saying that "...of course, we have something of a vested interest in seeing the project brought to a successful completion," ORNL was still expressing its interest in continuing participation in the RWDPP program after ERDA selected Sandia to carry out scientific studies at Los Medanos, William C. McClain to J.J. Schreiber, September 16, 1975, *ibid*.

18. Memo, "Vacation Deferral," Jerry D. Kennedy to R.J. Blount, March 13, 1975, binder "Miscellaneous & Administrative Correspondence," 101, 4/23/75 to 11/23/76, IRT box/index no. 123291, SWCF. Another source states: "In April 1975, ERDA assigned to Sandia Laboratories the responsibility for all aspects of conceptual design, development and implementation of a Waste Isolation Pilot Plant (WIPP) to be located in southeast New Mexico about 50 km east of the City of Carlsbad." Wendell Weart, *New Mexico Waste Isolation Pilot Plant: A Status Report*, SAND76-5992 (Albuquerque, NM: Sandia Laboratories, n.d.), p. 1.
19. Leo Scully, Memorandum of Record, "Discussions with ERDA/HQ—October 29, 1975," Book One—Correspondence, May 14, 1975 thru June 30, 1976, Sandia Laboratories R.W.P.P., binder 102, IRT box/index no. 123291, SWCF.
20. Weart, interview, May 28, 1996. Weart paraphrased Glenn Fowler's quote from memory.
21. U.S. Energy Research and Development Administration, Albuquerque Operations Office, and Sandia Laboratories, "Construction Management Plan for Waste Isolation Pilot Plant (WIPP), Located in Los Medanos, Southeastern New Mexico," November 30, 1976, p. 4, WC, SCA.
22. Ibid., p. 1
23. Les Hill, interview, October 30, 1996, OHC, SCA.
24. Steve Lambert, interview, April 22, 1996, OHC, SCA; see also, Banister, *Historical Sketches of Sandia National Laboratories Nuclear Field Testing*, pp. 7, C-10.
25. Richard Rhodes, "Waste of the Pecos," *Playboy*, August 1979, p. 208.
26. Wendell D. Weart to Terry Lash, June 2, 1976, binder, "Sandia Laboratories R.W.D.P.P. day file," #59, May and June 1976, IRT Box 123291, SWCF
27. Related by Mel Merritt, who was an eyewitness.
28. Ibid.
29. Weart, interview, May 28, 1996.
30. Herman E. Roser to F.P. Baranowski, "Status Report—RDWPP Program," Sept. 19, 1975, Book One—Correspondence, May 14, 1975 thru June 30, 1976, Sandia Laboratories R.W.P.P. #102, IRT box/index No. 123291, SWCF.
31. Delacroix Davis to Carl W. Kuhlman, January 22, 1976, *ibid.*
32. Les Hill, September 12, 1997, E-mail, WC, SCA and Steve Lambert, interview, April 22, 1996.
33. Philip M. Boffey, "Radioactive Waste Site Search Gets Into Deep Water," *Science*, vol. 190 (24 October 1975): 361.
34. Lambert attributes this remark to Les Hill. Lambert continues: 'The anecdote I remember was that I had done a doctoral thesis on the geochemistry of active hydrothermal systems. 'Hydrothermal' related to 'hydrology,' because both words had the first 5 letters in common....There were numerous instances in which electrical and mechanical engineers were being assigned to do geology (whether or not having attended Sandia's 6-week short course in Earth Science for

Sandia Engineers)....this was a condition typical of the time (the middle '70's), and needs to be evaluated in the historical context of that time. Sandia's proof of technical competence back then was whether the bomb blew up at the right time at the right place without any help from the wrong people, regardless of whether the designers held advanced degrees in weapons-design engineering. Dealing with the givens of the geology (which could neither be designed to specifications nor characterized to a specified tolerance) and other such inexact sciences was a new (and for some line managers, uncomfortable) venture for Sandia at the time. [In other words] in numerous instances the technical leadership of a project or sub-project did not entail detailed expertise equivalent to a graduate degree in the particular technical discipline, and that the detailed expertise was commonly contributed by other agencies (in the case of the WIPP hydrology, the Water Resources Division of the U.S. Geological Survey). Steve Lambert, E-mail, December 1, 1998, WC, SCA.

35. Lambert, interview, April 22, 1996.

36. Ibid.

37. "Site Selection and Characterization for the Waste Isolation Pilot Plant," videotaped interview with Wendell Weart, Les Hill, George Griswold, Pete Seward, Robert Statler, Dennis Powers, and Jerry Mercer, October 31 and November 1, 1996, SAND96-2632, Tape #1, WC, SCA.

38. "At the End of this Road: N-Waste Dump," *Albuquerque Journal*, December 18, 1977, p. B-4.

39. "Experience and Technical Capabilities of Tecolote Corporation," attachment to George B. Griswold to Dr. W.D. Weart, August 18, 1980, IRT box/index No. 123300, SWCF.

40. Weart, interview, May 28, 1996.

41. "Site Selection," SAND96-2632.

42. Ibid.

43. Weart, interview, May 28, 1996.

44. Luther I. Carter, *Nuclear Imperatives and Public Trust* (Washington, D.C.: Resources for the Future, Inc., 1987), p. 179.

45. George B. Griswold to Wendell D. Weart, "Site Selection Criteria at Los Medanos May Need to be Modified Resulting in Change of Location," May 3, 1976, binder, "Sandia Laboratories R.W.D.P.P. day file," #59, May and June 1976, IRT box/index No. 123291, SWCF.

46. F.P. Baranowski to R.G. Bradley, et al., "Nevada Terminal Storage," February 26, 1976, Book One—Correspondence, May 14, 1975 thru June 30, 1976, Sandia Laboratories R.W.P.P. #102, IRT box/index no. 123291, SWCF.

47. Delacroix Davis, Jr. to A.W. Snyder, "Nevada Terminal Storage Meeting," March 9, 1976, *ibid.*

48. Wendell D. Weart to Delacroix Davis, "Sandia Laboratories Position on High Level Waste for the WIPP," March 17, 1976, *ibid.*

49. Delacroix Davis, Jr. to W.D. Weart, "Definition of the Role of the WIPP at Los Medanos," April 12, 1976, *ibid.*

50. Wendell D. Weart to Wayne Knowles, January 26, 1976, *ibid.*

51. "...outline of significant activities regarding the Bedded Salt Program in southeastern New Mexico," p.4, Book One—Correspondence, May 14, 1975 thru June 30, 1976, Sandia Laboratories R.W.P.P. #102, IRT box/index No. 123291, SWCF.
52. For a complete documentation of boreholes at the WIPP site, see Leslie R. Hill, Richard Aguilar, Jerry W. Mercer, and Gretchen Newman, *Condensed Listing of Surface Boreholes at the Waste Isolation Pilot Plant Project through 31 December 1995*, SAND96-1960 (Albuquerque, NM: Sandia National Laboratories, January 1997).
53. Lambert, interview, April 22, 1996.
54. Ibid.
55. Ibid.
56. Wendell Weart, written communication, November 4, 1998, WC, SCA.
57. Terrence R. Fehner and Jack M. Holl, *Department of Energy, 1977-1994: A Summary History* (Washington, D.C.: Department of Energy, 1994), p. 19.
58. F.C. Gosling and Terrence R. Fehner, "Closing the Circle: The Department of Energy and Environmental Management, 1942-1994," draft, Washington, D.C., Executive Secretariat, Department of Energy, 1994, p. 9, SCA, p. 23. The remainder of the Department was composed of the Federal Energy Administration, the Federal Power Commission, and assorted components of Interior, Commerce and other agencies. All told the unified DOE employed about 20,000 people and had a budget of \$10.4 billion. All these existing agencies and offices were not simply organized under new management but many programs and functions were reshaped to fit the Carter administration's national energy policy.
59. Ibid., p. 25.
60. Phil Niklaus, "Skeptical Senator Faults Energy Dept.'s Candor," *Albuquerque Journal*, December 22, 1977, p. A-1.
61. "Schmitt Suggests Parley With Schlesinger on N-Waste," *ibid.*, December 24, 1977.
62. Phil Niklaus, "New Mexico's Reputation is Distorted," *ibid.*, October 30, 1977, p. B-2.
63. U.S. Department of Energy, *Report of Task Force* (February 1978), pp. 2-22, 45, quoted in Gosling and Fehner, "Closing the Circle," p. 25-26.
64. Carter, *Nuclear Imperatives*, p. 178.
65. Rhodes, "Waste of the Pecos," p. 132.
66. *Ibid.*, pp. 132, 158.
67. Weart, interview, May 28, 1996.
68. Paul R. Wieck, "N.M. Will Have Power to Veto N-Waste Project," *Albuquerque Journal*, February 3, 1978, p. A-1.
69. Carter, *Nuclear Imperatives*, p. 185.

70. Paul R. Wieck, "Schlesinger To Get Stiff Test," *Albuquerque Journal*, March 26, 1978, p. B-3.
71. Carter, *Nuclear Imperatives*, p. 187.
72. Phil Niklaus, "DOE Finds Public Atop Nuclear Issues," *Albuquerque Journal*, April 23, 1978, p. E-5.
73. Ibid.
74. Phil Nicklaus, "AG Urges Moratorium On N-Waste Site Funds," *ibid.*, April 13, 1978, p. A-1
75. Carter, *Nuclear Imperatives*, p. 186.
76. Paul R. Wieck, "Sibling Rivalry Over WIPP Could Muddy Real Issues," *Albuquerque Journal*, June 30, 1978, p. B-3; *idem*, "N-Waste Vote Sets Stage for Fight," *ibid.*, May 12, 1978, p. A-8.
77. Eugene Ward, "WIPP Evaluation Group Leader Knows He Will Make Enemies," *ibid.*, November 24, 1978, p. E-9. *See also*, Wally Gordon, "Santa Fean Burdened With Deciding WIPP's Safety," *ibid.*, October 3, 1981, p. E-4.
78. Carter, *Nuclear Imperatives*, p. 186.
79. Ibid.
80. A.W. Snyder to Delacroix Davis, March 19, 1976, R.W.P.P., #102, Memo of Record, Discussions with Headquarters, IRT box/index no. 123291, SWCF.
81. Hill, et al., *Condensed Listing of Surface Boreholes*, SAND96-1960, p. 9.
82. Wendell D. Weart to Delacroix Davis, Jr., "Land Withdrawal for WIPP," June 21, 1976, Book One—Correspondence, May 14, 1975 thru June 30, 1976, Sandia Laboratories R.W.P.P. #102, IRT box/index No. 123291, SWCF.
83. Les Hill, personal communication, February 26, 1998.
84. Wendell Weart elaborated: "Dead Cow Road is not an official name—Refinery Road is—but is a name given when a cow killed by an auto at a 'blind dip' in the road was left to bloat. At some point in this process an unnamed individual spray painted a 'Circle Bar W' on the side of the poor critter. Since it was seen by so many WIPP commuters, it just came to be referred to as Dead Cow Road, by general consensus." E-mail, December 1, 1998, WC, SCA.
85. Wendell D. Weart to distribution, memo: "Automobile Traffic in Southeast New Mexico," August 6, 1976, Correspondence April 23, 1975 to November 23, 1976, Sandia Laboratories R.W.P.P. #101, IRT box/index no. 123291, SWCF.
86. Weart, interview, May 28, 1996.
87. "Labs scientist conducts study of German waste disposal facility," *Sandia Science News*, April 1978.
88. Delacroix Davis, Jr. to A.W. Snyder, "WIPP EIS," March 16, 1976, Correspondence April 23, 1975 to November 23, 1976, Sandia Laboratories R.W.P.P. #101, IRT box/index No. 123291, SWCF.
89. Delacroix Davis, Jr. to distribution, "Technical Alternatives Document (TAD)," June 7, 1976, *ibid.*
90. "Environmental/NEPA Issues for the Waste Isolation Pilot Plant," videotaped interviews with Mel Merritt, Pat Brannen, Felton Bingham, Sieglinde Neuhauser, and Wendell Weart, November 13, 1996, SAND96-2721, WC, SCA.



91. Ibid.; Baseline studies were conducted of various elements of the flora and fauna in the area of the WIPP site. Much of this work was published in, T.L. Best and K.S. Neuhauser, *A Report of Biological Investigations at the Los Medanos Waste Isolation Pilot Plant (WIPP) Area of New Mexico During FY 1978* (Albuquerque, NM: Sandia National Laboratories, 1978). The physical collections (pressed plants, animal specimens) were stored in the University of New Mexico Herbarium and elsewhere. See also, Sieglinde Neuhauser to Carl J. Mora, "Re: Clarification," July 2, 1998, E-mail, WC, SCA.
92. Melvin Merritt, "A transcription of some WIPP-related material from Mel Merritt's personal notebooks written at the time," manuscript, November 4, 1996, WC, SCA.
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99. Tessier, "Lujan Favors One of Options On WIPP," *ibid.*, April 20, 1979, p. A-1.
100. Idem, "Emotions Erupt at First WIPP Hearing," *ibid.*, June 8, 1979, p. A-3.
101. Robert H. Neill, James K. Channell, Carla Wofsy, Moses A. Greenfield, eds., *Radiological Health Review of the Draft Environmental Impact Statement (DOE/EIS-0026-D) Waste Isolation Pilot Plant, U.S. Department of Energy, EEG-3* (n.p.: Environmental Evaluation Group, Environmental Improvement Division, Health and Environment Department, State of New Mexico, August 1979).
102. E. C. Hardin Jr., Advisor to Director, Office of Nuclear Waste Management to Morgan Sparks, President, Sandia Laboratories, telecommunication message, June 12, 1979, WC, SCA. Felton Bingham commented: "His [Hardin's] glowing remarks show that not everybody sneered at that document—that some people actually thought it praiseworthy. And his opinion seems even more important because he was a beloved figure: a street and a parade ground on the base are now named for him." Felton Bingham, written communication, May 17, 1999, WC, SCA.
103. "Conceptual Design and Equipment Development for the Waste Isolation Pilot Plant," videotaped interviews with Leo Scully, Robert Stinebaugh, John Milloy, and Wendell Weart, April 23, 1997, SAND97-0953, WC, SCA.
104. Ibid., and Leo Scully, E-mail, March 31, 1999, WC, SCA.
105. Powers, et al., *Geological Characterization Report*, SAND78-1596, pp. 3-60—3-62.
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Drum mining machine used to excavate the waste rooms and drifts.

# Chapter 2

## DEVELOPING THE WIPP SITE (1980 – 1988)

*It's a painful, frustrating, bitchy interface because of the complexity of the interactions.*  
Bob Peurifoy, Sandia VP

*The start's the thing,  
The song to sing  
is not the end  
Nor yet the way.  
The thing to sing  
Must be the start,  
So brave, so big,  
So shrewd, so smart*

“Boring Within and Without,” Pogo as told to Walt Kelly<sup>1</sup>

Early in 1980, the prospects for the WIPP project were still not encouraging. President Carter signed a bill authorizing construction near Carlsbad of the nation's first permanent repository for radioactive defense wastes. However, despite signing the bill, Carter said he was “not endorsing this [the WIPP] approach” to nuclear waste disposal. Although \$87 million had already been spent on the WIPP project, the President reportedly decided to scrap it in favor of a more cautious nuclear waste disposal approach recommended in a study done by the Interagency Review Group (IRG)—a group of federal agencies that Carter had designated to evaluate and recommend U.S. policy on radioactive waste management.<sup>2</sup> The IRG considered the use of the WIPP facility and concluded that it was inadvisable to operate it solely as a defense waste facility. Their final report published in March 1979 questioned whether WIPP was justified as a defense-waste-only facility and questioned its justification as an intermediate-scale facility, which was the mission proposed if WIPP were to accept the thousand canisters of commercial spent fuel proposed by Deputy Secretary of Energy Jack O'Leary in late 1978. O'Leary's proposal was partly in response to a referendum passed in California in 1976 which required that the isolation of nuclear waste be demonstrated before any additional commercial nuclear power plants could be licensed.<sup>3</sup>

### Final Environmental Impact Statement Published

In October 1980, after 13 months of work, mostly by Sandians, which included several preliminary reports subjected to public scrutiny, DOE published the Final Environmental Impact Statement (FEIS) in two thick volumes, which stated that a 10-acre underground repository for nuclear wastes would be excavated near

Carlsbad in the first phase of the proposed WIPP. This initial phase was designed to confirm characteristics of the WIPP site by drilling two shafts to a depth of about 2150 feet. The project would also entail construction of about eight acres of underground experimental rooms. These rooms would be used for tests on the corrosion of nuclear waste containers, backfill materials and seals, and the mechanical behavior of the salt beds under ambient and elevated temperature conditions. The FEIS stated that radioactive materials would not be used in the experimental stage of the plant.<sup>4</sup>

The DOE imposed a December 8 deadline for the state to respond, which prompted Governor Bruce King to exclaim, "I am deeply concerned that we have adequate time to respond to such an important document." King said that the final document was "significantly different" from the previous draft documents. In early November, King asked for a 45-day extension of the December 8 deadline which DOE refused to grant because it was not required to do so.<sup>5</sup>

## **Disagreements Over WIPP**

President Carter's bill had designated the salt beds near Carlsbad as one of four or five sites to be evaluated for the first permanent repository for high-level military and commercial radioactive waste. And Carter's plan would not give the states veto power over the establishment of waste facilities within their boundaries. The first site would be selected in 1985 and opened in the early 1990s, if Congress cleared the way. The other potential sites were the salt domes along Louisiana's Gulf Coast, salt beds in west Texas and Louisiana, the basalt rock formations at Hanford, Washington, and the volcanic tuff beds at the Nevada Test Site.<sup>6</sup>

The President's decision put him on a collision course with Senator Henry M. Jackson of Washington, chairman of the Senate Arms Control Subcommittee which originally authorized WIPP, and with Illinois Representative Melvin Price of the House Armed Services Committee. Price, saying he was "dismayed to learn that the administration now plans to abandon the project," sought additional funds for WIPP as authorized by Congress as a test facility for defense-related transuranic waste. Carter then asked that the authorized funds be "reprogrammed" and that Congress appropriate \$22 million to purchase the WIPP site so it could be put in a "site bank" from which the high-level repository would be chosen. If Congress went along with Price over Carter, the DOE would have to proceed with WIPP because the impoundment act passed during the Nixon administration required that the executive branch spend funds appropriated by Congress for the originally intended purposes.<sup>7</sup>

The upshot of the political infighting between the White House and Congress was that Carter requested that Congress rescind \$17 million earmarked for plant and capital equipment for WIPP. This was opposed by both Representative Price and



Senator Jackson who asked the House Energy and Water Development Appropriations subcommittee to put additional funds for WIPP in the Fiscal Year 1980 supplemental budget bill.<sup>8</sup> In May 1980, the House Appropriations Committee rescinded \$13 million for the WIPP, “thus adding to the growing confusion over the fate of the project.”<sup>9</sup> Then on June 12, the same committee quietly restored the funds for WIPP.<sup>10</sup> Finally, on October 2, 1980, President Carter signed an appropriations bill that provided \$20 million for WIPP for Fiscal Year 1981. The bill earmarked \$15 million for preliminary construction and \$5 million for operations.<sup>11</sup>

What this meant for Sandia was that its WIPP funding was drastically, albeit temporarily, cut from \$14.5 million to \$2 million, “barely enough to keep body and soul together for key people,” observed Wendell Weart.<sup>12</sup> But the Sandia scientists persevered in the face of this brief funding obstacle, reducing expenses to the minimum and continuing their site studies as best they could until their funding was restored.

## **Sandia’s Site Investigations**

From 1975 through 1981, extensive site investigations had been carried out at the WIPP site to determine both the stratigraphy and structure of the salt beds and to determine the hydrology of the region. Les Hill had initially supervised this work with George Griswold conducting the geologic studies as described in Chapter 1. ERDA-9, Sandia’s first exploratory borehole drilled at the proposed site in 1976, had encountered expected favorable underground conditions after ERDA-6, drilled in 1975, discovered steeply dipping beds, brine, and noxious gases. When Dennis Powers took over the supervisory task from Les Hill in 1980, an earlier WIPP drill hole (designated WIPP-12) about a mile north of ERDA-9 was deepened under the auspices of a Westinghouse subcontractor between November 17, 1981, and January 1, 1982.<sup>13</sup> Deepening was offered to the Environmental Evaluation Group (EEG) in preference to drilling a new exploratory hole. It encountered a brine reservoir similar to the one found by ERDA-6 even though the deformation of the anhydrite beds believed responsible for the brine accumulation was much less pronounced. The occurrence of brine in the Castile anhydrites launched Sandia into numerous studies, not only of the consequences of their occurrence, but of explanations of the processes that created the brine reservoirs and the timing of their development. Both the state of New Mexico, through the EEG under Robert Neill’s direction, and the DOE examined a number of radionuclide-release scenarios involving these brine reservoirs, which could give rise to the release of radioactivity to the biosphere. Both the state, represented by EEG, and DOE eventually concluded that “there were no unacceptable consequences of these scenarios.”<sup>14</sup>

Two of the nine deep boreholes drilled by the DOE and its predecessor agencies between 1975 and 1982 had encountered brine reservoirs. The holes were drilled within an eight-mile radius of the WIPP repository’s projected central shaft. The

EEG regarded the presence of pressurized brine reservoirs beneath the WIPP site as a long-term concern, anticipating the time when administrative control and even knowledge of the site's existence might be lost. If some such drillers in the far future looking for oil or natural gas happened to drill into such a reservoir, brine would rise up through the Salado, enter the repository, then continue up through the Rustler aquifers and on up to the surface, dispersing radioactivity.<sup>15</sup>

The conclusions on release scenarios reached by EEG and DOE over the brine issue did not satisfy the opponents of WIPP and disagreements continued for years. An EEG consultant at the time gave a pithy analysis of the controversy:

The WIPP site is in a region of complex hydrogeology that results in a setting almost unique in composite terms. Both conventional studies and specialized approaches have been necessary to minimize the questions and uncertainties. One might question the WIPP site as a candidate for a waste-storage plant if the hydrogeology is complex and if uncertainties, however small, still persist. On the contrary, the best candidate for the waste should logically be in an unusual setting.

We start with the premise that if there were no moving ground water anywhere, radioactive and other hazardous wastes could be buried in the ground almost anywhere without harm. Thus, the ever-present and ever-moving ground water is the major concern in all cases. Even if a zone at depth is found where water is not present, an additional requirement would be that no aquifers lie above or below this zone of "no-water occurrence or movement." These constraints essentially eliminate all simple and conventional hydrogeologic settings.

The point to be made is that only an unusual hydrogeologic setting, such as the WIPP site, is likely to be an acceptable one. It follows that complex hydrogeology that requires special study surrounds such a setting.<sup>16</sup>

The brine reservoir encountered by WIPP-12 was only a mile north of the center of the WIPP site. In spite of the lack of "unacceptable consequences" agreed upon by the state of New Mexico and DOE, the state asked DOE to consider reorienting the disposal rooms to the south of the shaft rather than to the north, as had been planned, which DOE agreed to do. Sandia supported the reorientation largely because it would better separate experimental activities from the disposal area and minimize operational conflicts.

In October 1980, Sandia provided, at DOE's request, an interim evaluation of the site's acceptability. This evaluation stated, in effect, that the Los Medanos site was still considered satisfactory as a pilot plant site location and recommended that the work should proceed and additional geotechnical data should be gathered. This evaluation was meant to provide additional support for commencing the Site and Preliminary Design Validation (SPDV) program and as a justification for proceeding with that activity. In November 1980, DOE applied to the Department of Interior for the administrative withdrawal of the Los Medanos land for the SPDV experiments. On January 28, 1981, DOE published a Record of Decision—the final federal step needed to authorize the additional construction stage.<sup>17</sup>

## First In Situ Tests

In 1981, a “very useful learning experience,” in the words of Martin Molecke, was afforded by Mississippi Chemical Mine Company when it allowed Sandia to conduct the first in situ tests in one of its potash mines not far from the vicinity of the future WIPP site. Molecke, with the invaluable help of Sandia’s instrumentation group, which included Chris Christiansen, Jim McIlmoyle, John Loukota, and Len Krakio, designed a series of four tests. Three tests examined the role of fluid migration in salt formations. Laboratory and field tests were designed to evaluate computer models that were being developed to address moisture transport, effects of temperature, temperature gradient, and stress.<sup>18</sup>

Molecke also designed a waste package materials field test that was conducted in a halite deposit of the Mississippi potash mine. The primary purposes of this test were to evaluate the thermophysical and chemical performance of candidate high level waste package backfill materials emplaced in rock salt and the corrosion behavior of candidate waste canister or overpack alloys. This field test series also served as a precursor to future WIPP in situ waste package performance experiments on simulated defense high-level waste packages, serving to develop applicable testing, instrumentation, and sampling techniques.<sup>19</sup>

The tests were conducted in a tunnel about 1000 feet below the surface. “It was interesting,” Molecke recalled. “In a lot of places, you couldn’t even stand up straight.”<sup>20</sup> But these tests gave Molecke and the other Sandia scientists their first opportunity to work underground in an environment similar to the



Marty Molecke in the Mississippi Chemical Mine Company potash mine in 1981. He is holding a test heater used for simulated defense high level waste. Corrosion samples are bolted onto the test heater at bottom. Behind Molecke is a data logger inside an environment control box (to protect the instrumentation from salt dust).



actual WIPP site, which would not be ready for underground in situ tests until another two years when the first exploratory shafts were planned to be drilled.

## **DOE versus the State of New Mexico**

Early in 1981, with the newly inaugurated President Ronald Reagan in the White House, the DOE announced it “would proceed with a nuclear waste burial site in salt beds near Carlsbad and waste [would] start arriving within six years.” State officials were dismayed when WIPP project manager Joseph McGough declared in an Albuquerque news conference, “We don’t need anything else from the state, legally or officially.” He stated that all DOE needed to begin the project was the permission of the U.S. Bureau of Land Management for use of the land and a “continued flow of money from Congress.”<sup>21</sup> To which Governor King replied that he was “very disappointed” the state had not been “kept abreast” of the DOE’s plans and that “there isn’t much the state can do about WIPP now.”<sup>22</sup>

New Mexico Attorney General Jeff Bingaman (and U.S. Senator from 1983 on) “angrily warned” the Reagan administration that he might file suit to block the WIPP project if the federal government continued to “ignore the state’s legitimate concerns.” In a letter to James Edwards, the new DOE secretary, Bingaman wrote that the decision to begin WIPP construction “without first resolving the state’s legitimate legal and public health and safety concerns, is a flagrant abuse of federal power and a breach of trust with the government and citizens of New Mexico.”<sup>23</sup>

Quickly joining the public fray was Don Hancock who would become WIPP’s most persistent opponent. He was director of an anti-nuclear advocacy group called the Southwest Research and Information Center (SRIC), a self-described private, non-profit educational and scientific organization based in Albuquerque. He characterized the Final Environmental Impact Statement as “legally insufficient” quoting a letter from the outgoing legal counsel of the Department of Interior. Hancock, at a news conference, charged the environmental report “violate[d] two principles of the National Environmental Policy Act requiring the environmental statement to discuss a defined purpose and proposed action, and to assess all reasonable alternatives to the proposed action....The Department of Energy has yet to comply with these two principles on the shaft-sinking program.”<sup>24</sup>

## **The Consultation and Cooperation Agreement and the Veto Controversy**

Drilling on the first exploratory shaft began on July 4, 1981, which ushered in the SPDV experiments at WIPP, as required by the Consultation and Cooperation agreement finally signed between New Mexico and the DOE on July 1, 1981.<sup>25</sup> This agreement, which recognized the state’s right to comment on and make



A 1981 view of the drilling rig used for boring the exploratory shaft.

recommendations concerning the public health and safety aspects of the WIPP project, had been stipulated by the WIPP Authorization Act of 1979. But differences in interpretation between New Mexico officials and the DOE on whether the state had a veto power over the project delayed the agreement's finalization. This debate about New Mexico's veto power (and the larger one of whether states could prevent projects on federal lands) had its origin in 1978 when James Schlesinger, who was Energy Secretary at the time, apparently promised a delegation of New Mexico politicians that the federal government would not build a nuclear waste disposal pilot project in New Mexico without the approval of the state government. Such a veto power was determined to be unconstitutional by Congress and the DOE General Counsel but state officials continued to insist that they had been promised this authority.<sup>26</sup>

Previously, on May 14, 1981, New Mexico Attorney General Jeff Bingaman had filed suit with the U.S. District Court to halt work on the WIPP to "vindicate rights guaranteed to the state of New Mexico." Bingaman announced the lawsuit at a televised press conference in his Santa Fe office. He stressed that his objective was "not to kill WIPP but to force Washington to recognize the state's concerns," adding "...What I am opposed to is the manner in which the DOE has dealt with New Mexico."<sup>27</sup>

This impending court action motivated the DOE and New Mexico to agree upon and sign a Stipulated Agreement that would permit WIPP activities to proceed but which would allow state review at critical junctures. The agreement required that DOE prepare sixteen topical reports summarizing the results of all experiments and studies conducted during the SPDV and site validation phases of the WIPP project and provide them to EEG. These reports were prepared by Sandia.<sup>28</sup> The Consultation and Cooperation Agreement was also signed as a part of that Stipulated Agreement, which allowed work to proceed on the SPDV experiments. With the agreement's finalization, Bingaman withdrew his suit to stop the WIPP project until state concerns had been addressed by the DOE. "It took the lawsuit to get the DOE to sit down and discuss the disputed areas in a manner that was acceptable to the state," the attorney general commented. "The lawsuit," Bingaman added, "forced [Energy Secretary James] Edwards to address what [I] believed are the two main disputed procedural points." One was whether the agreement was enforceable in the courts and the other whether it would provide that New Mexico did not waive its right to judicial review of any decision Edwards might make on WIPP. "New Mexico won both points," according to Bingaman.<sup>29</sup>

## **The Site and Preliminary Design Validation (SPDV) Experiments**

The objectives of the SPDV experiments were to "enhance the level of confidence and credibility of the current design of haulageways and storage rooms." To do this, it was necessary to have some preliminary data showing that the haulageways

and storage rooms would remain stable during the waste emplacement and potential five-year-retrieval period. Construction of the SPDV access shafts and underground area began in mid 1981 and was completed in 1983. This phase encompassed the following excavations: two shafts down to the proposed facility depth of 2150 feet; a network of underground drifts and crosscuts to support the SPDV program; an exploratory drift to the south extending the full length of the facility; a four-room test panel to the north, also to support the TRU storage room design validation program. SPDV construction was followed by underground development of the various test rooms excavated for the experimental program. The US Army Corps of Engineers managed construction of the test rooms beginning in November 1983 and completed work in April 1985. The work included excavating the in situ test areas and widening the second shaft by down-slashing (drilling and blasting), and by sinking a new exhaust shaft by raise-boring (drilling upward) and subsequent down-slashing.<sup>30</sup>

The logic supporting the sinking of shafts to access the WIPP underground facilities was based on the need for the site to be validated by direct observation of the host salt beds. The proposed design for the underground facility needed in situ validation as well. Hence the acronym SPDV—Site and Preliminary Design Validation.

The Site Validation program, specified by Sandia and Bechtel and conducted in the field by Westinghouse and other contractors, consisted of two perpendicular drifts, or horizontal tunnels, about one mile in length. These drifts explored the one-mile square centered on the exploratory shafts and examined the area proposed for possible waste emplacement. Geologic mapping and detailed geochemistry confirmed that the site was satisfactory and resulted in a site validation report—a portion of which was Sandia's continued endorsement of the site to DOE.

The Design Validation program consisted of four rooms identical to the planned waste rooms. These rooms were monitored to ascertain their behavior from 1983 until the area was closed in 1995. Bechtel designed these tests and used the data in their design validation, but Sandia later adopted one of the rooms for its own waste package experiments and used the ground motion data in its own rock mechanics program. Most of Sandia's rock mechanics and in situ tests were separate from the SPDV program.

The SPDV program would validate the design for the WIPP access shafts and TRU waste disposal rooms, and evaluate the amount and rate of shaft convergence and room creep deformation correlating these with model predictions. The experiments would also evaluate instrumentation systems for accuracy and the reliability of measurements made with them in rock salt, and would document the suitability of the system for future measurements. The response of in situ formations such as clay seams and other material layers in addition to the salt would be evaluated, and large quantities of rock salt samples and other sample materials were to be

collected and subjected to laboratory tests to determine their mechanical properties.<sup>31</sup> The Site Validation portion of the SPDV was to confirm the geology predicted from surface-based studies by mining drifts a mile north-south and a mile east-west and conducting detailed geologic mapping.

To implement the SPDV work, drilling began, as mentioned above, on two shafts on July 4, 1981. A drift was constructed to the southernmost extent of the anticipated disposal area and four rooms were constructed in the northern part of the disposal facility. These rooms simulated the geometry scale of the waste disposal rooms to be constructed eventually for the TRU waste isolation. This work was completed for the most part over the next year and a half. By March 1983, Sandia had provided a report to DOE which indicated the site still appeared acceptable from the geologic and hydrologic points of view based on the underground site validation studies and recommended that DOE proceed with full construction of WIPP. On the strength of Sandia's recommendations, Westinghouse issued an SPDV Report which concluded that the site, both surface and underground, appeared to be acceptable. The report stated that Westinghouse would proceed with full construction.<sup>32</sup>

In addition to the SPDV tests required by the Consultation and Cooperation Agreement, Sandia was anxious to start its own series of in situ tests, some of which up till now had been carried out in the Mississippi Chemical Company potash mines, as described above. Two types of tests were contemplated: In situ tests without radioactivity and in situ tests with radioactivity. Nonradioactive tests were principally rock mechanics experiments, studies of seals and waste package behavior, and demonstrations of repository operations. The tests proposed with radioactivity addressed primarily waste package interactions with the salt environment, and included options for radiation-source experiments, tests with actual defense high-level wastes (DHLW), and demonstrations with TRU wastes and DHLW. All these tests were gathered under the WIPP R&D Program and focused on the technical issues of isolating radioactive wastes in bedded salt. The tests were based on an assessment of current knowledge about the interactions of materials and systems involved, and were designed to examine that knowledge under actual environmental conditions. In late 1982, Sandia published a report that fully outlined this series of tests.<sup>33</sup>

The go-ahead to actually begin drilling shafts at the WIPP site was not welcomed by everyone. "With tombstones, picket signs and Woody Guthrie tunes," about fifty people demonstrated at the Albuquerque WIPP headquarters to protest construction of the repository.<sup>34</sup> On Labor Day, about 150 demonstrators, mostly from Albuquerque and Santa Fe, staged a peaceful protest at the WIPP site. Twenty-one activists and eight media representatives were arrested when they attempted to enter the buffer zone near the site. Displaying a New Mexico state flag, the peaceful protestors walked through a barricade at the WIPP site and systematically were charged with criminal trespassing.<sup>35</sup>

## Designing the TRUPACT-I Shipping Container

Now that actual shafts were being drilled, the question of how to transport the military wastes from their storage sites to WIPP acquired a new urgency. Most of the waste expected to be shipped to the WIPP site was contact-handled (can be handled without shielding because radiation levels are low) TRU waste that at the time was being shipped from the Rocky Flats Plant near Denver, Colorado to the Idaho National Engineering Laboratory near Idaho Falls. This waste was being shipped in ATMX-600 series railcars.<sup>36</sup>

The low-level TRU nuclear waste container that had been in use for 10 years was known as the “6400” or “Super Tiger.” Designed to be hauled by a semi-trailer rig, as well as by rail, the Super Tiger was made of two rectangular steel shells, separated with rigid, fire-retardant polyurethane foam, according to the WIPP Environmental Impact Statement. At this time, the Super Tiger was being used for shipping Type B quantities of radioactive materials by both truck and rail. This alternative packaging for contact-handled TRU waste was the only packaging being used for truck shipment. Although designed as a general-use packaging for the shipment of materials in Type B, the Super Tiger was frequently used to hold Type A drums or boxes.<sup>37</sup> There are various Type B containers designed to move on railroad cars. These containers carry the same types of waste as Type A containers, only in larger quantities. Radiopharmaceuticals and other small amounts of radioactive materials are carried in the Type A packages. Special packages for Type B quantities of radioactive material are required by Title 10, Code of Federal Regulations, Part 71 (10CFR71). (The appendix to 10CFR71 contains a list of isotopes. If a shipment has less than the quantity listed, it is a Type A quantity that requires a Type A package. If it is more than that quantity, then a Type B package is needed. Type B packages require the full regulatory tests: drop, puncture, burn, etc. A Type A package has lesser requirements and is often used for such items as small quantities of medical or industrial isotopes.<sup>38</sup>)

However, after 10 years of use, the Super Tiger containers were “worn, torn and no longer acceptable for prevention of waste leakage.” So the Nuclear Regulatory Commission and Sandia announced jointly that “all-new packaging [would] be created for WIPP” and that a “prototype” would be built in 1981.<sup>39</sup> Robert Jefferson, the first director of Sandia’s Transportation Technology Center (TTC),<sup>40</sup> said, “There was never any intent to use the Super Tiger for WIPP anyhow.” Jefferson’s group was designing TRUPACTs, an acronym for transuranic package transporters. “The Super Tiger was a very simple package and the TRUPACT is somewhat more refined,” Jefferson indicated. “We’re designing a total system, rather than just a box.”<sup>41</sup>

Sandia had actually begun designing the TRUPACT-I package in 1978, using a standard cargo box concept.<sup>42</sup> As stated in the Final Environmental Impact Statement, the conceptual design for the rail version of the TRUPACT-I was

formalized during 1979, with detailed design and scale model tests scheduled for 1980. In 1980-81, a safety analysis report would be prepared, and a prototype of the rail TRUPACT-I was to be fabricated during 1981. Prototype testing and licensing was scheduled to be completed by 1983, with commercially produced rail TRUPACTS to be available in 1986. A TRUPACT-I for truck transport would be developed concurrently, paralleling the sequence for rail TRUPACTS.<sup>43</sup> The development and testing program was outlined in a paper given at an international conference.<sup>44</sup>

TRUPACT-I design and testing continued at Sandia until 1987 when DOE finally rejected the design. Along the way, the concept of a rail TRUPACT was abandoned, and the container was designed for truck transport. The major problems had to do with hydrogen venting; it was known that the contents of the package would generate nonradioactive gas. To assuage this effect, a vent was designed to “burp” it, but as it turned out the state of New Mexico and EEG objected to the vented design. A full-size prototype TRUPACT-I was completed by General Atomic (Sandia’s contractor) in 1984, which Sandia sent to Oak Ridge National Laboratory for drop and puncture tests (because the container exceeded Sandia’s weight limit). It passed all the tests. In 1986, TRUPACT-I passed the fire test at Sandia, but the following year the lack of double containment and venting became major issues.<sup>45</sup>

Plans proceeded for constructing the redesigned but still problematic TRUPACT, as a double-walled design, or essentially a box within a box. In October 1986 Westinghouse announced that it would build TRUPACTS in Carlsbad at a new industrial park there. Westinghouse and city officials broke ground at the Carlsbad Airport Industrial Park for the project, which included a 24,000-square-foot assembly plant and an office building. Westinghouse officials said completion was scheduled for mid-January 1987.<sup>46</sup>



An early quarter-view TRUPACT-I development unit being prepared for a puncture test in the late 1970s. Examining the test setup is Richard Yoshimura (facing camera) who has been with the program since its inception in the mid-1970s.

All these developments were watched closely by the EEG, New Mexico's official DOE-sponsored watchdog over the WIPP project. EEG director Robert Neill summed up the TRUPACT-I problems:

DOE had a shipping container for the transportation of the contact-handled waste which violated DOE's own orders. It had single containment for shipments of plutonium in excess of 20 curies. NRC [Nuclear Regulatory Commission] required double containment. We pointed out that the design of that container was vented and violated both DOE orders and had it been subjected to NRC licensing, it wouldn't be allowed to operate on any highway in the country. After a running battle for three years [of EEG] with DOE, they abandoned that rectangular shipping container and went to a right circular cylinder. You might call it, if I may, a garbage can within a garbage can. That's what the current [1998] TRUPACT is.<sup>47</sup>

According to Richard Yoshimura, a member of Sandia's original package design group, Sandia proceeded with the design with the understanding that DOE would initiate a "rule-making" or petition the NRC to have contact-handled TRU waste made exempt from double containment requirements, which already exempted two materials: reactor fuel and plutonium metal or alloys of plutonium. Bob Sandoval, an engineer in Yoshimura's group, had designed a vent system that would work under all conditions, in hot and cold environments. Yoshimura said that there were mechanisms in the regulations to exempt these materials from the double containment requirement:

Regulations remained the same throughout this period of time. What was needed was for the DOE to move forward with a request for rulemaking in these two areas, and that was not done....DOE chose not to request exempting contact-handled TRU waste destined for the WIPP from the double containment requirements, also to [not] pursue venting of hydrogen gases.<sup>48</sup>

## **TRUPACT-I Scrapped and TRUPACT-II Started**

The result of the single-versus-double containment and hydrogen venting controversies was that Sandia's TRUPACT-I rectangular design was rejected by DOE in June 1987.<sup>49</sup> The DOE's decision was largely prompted by a contentious meeting in May of the Surface Transportation Subcommittee, chaired by Senator J.J. Exon (D-Nebraska), which was looking at a revision of the Hazardous Waste Transportation Act, and where the original TRUPACT design came under fire. Although DOE had the legal authority to certify the container on its own, the agency had promised in the Final Environmental Impact Statement that it would comply with both Department of Transportation and Nuclear Regulatory Commission standards for radioactive waste containers. This power of DOE to both write and certify its own regulations for TRUPACT was denounced at the Senate subcommittee meeting by Senator Brock Adams (D-Washington) who said, "The law should be changed." And he continued: "TRUPACT is a single theme that runs through this hearing and shows that the system doesn't work and that there should be an independent group that certifies DOE's regulations. We're about to launch a big new program at WIPP in 1988 and I think the system stinks. Why



shouldn't somebody else be looking at DOE's standards?" Testifying at the meeting, Robert Neill of the EEG told the subcommittee that DOE had made a "flat, unequivocal commitment to meet the standards of the Nuclear Regulatory Commission but now wanted to rewrite the regulations." Neill reiterated New Mexico's objection to the TRUPACT design because of the single-walled construction, rather than double-walled construction, as required by the NRC regulations. Neill pointed out that the current design also had an open vent that "operates continuously" in violation of NRC standards.<sup>50</sup>



A TRUPACT-II container being readied for a drop test at Sandia's Coyote Canyon Test Facility.

The DOE had asked the Transportation Department in February to impose a rule approving the “earlier, weaker design.” This request had been opposed by Governor Garrey Carruthers and four of the five members of New Mexico’s congressional delegation. Transportation put the request on hold and sent DOE a letter seeking more detailed information, which it never received. As a result of the subcommittee hearings where the TRUPACT and DOE’s certification policies came under severe criticism, it was decided to abandon the original container design.



A TRUPACT-II package being subjected to a fire test. The package had to survive a 1475° F fire for at least 30 minutes without losing vacuum on either of the two containment vessels.

“The new container also will have double walls and no vents,” said DOE spokesman David Jackson in Albuquerque. WIPP’s prime contractor, Westinghouse’s Waste Isolation Division, issued a request for procurement to design and fabricate a prototype container. Jackson said DOE had “no idea” what the cost or the appearance of the new container would be. And what about that building leased by DOE in Carlsbad to fabricate TRUPACT containers? “The Department of Energy will make sure the facility is used,” said Jackson.<sup>51</sup>

The DOE announced it was seeking bids from industry to develop a new container. The new container, to be carried on trucks and trains, would have to meet standards set by the Nuclear Regulatory Commission and the Department of Transportation, conditions that New Mexico had repeatedly urged DOE to meet.<sup>52</sup> A firm named Nuclear Packaging was awarded the contract to completely redesign the container, now called TRUPACT-II. Sandia was selected as DOE technical advisor. In 1988, the first prototype of TRUPACT-II passed structural tests, but its seals failed engulfing fire tests performed at Sandia. In 1989, the seals were redesigned and the package passed all tests, which were conducted by Sandia at its Coyote Canyon Test Facility.<sup>53</sup>

## **The First Shaft Drilled**

The drilling of the 12-foot-wide Exploratory Shaft, later the Construction and Salt-Handling Shaft, for the future WIPP repository was completed in late October of 1981 after more than three months of work. “We bottomed out at 2:15 p.m. Saturday afternoon [October 24],” announced DOE’s WIPP project manager Joseph McGough. The shaft, which workers began drilling on July 4, bottomed out at 2305 feet in salt beds at the site. The next few days were spent doing geophysical logs of the main shaft, and during the following three weeks, 850 feet of 10-foot-wide steel liner was inserted into the shaft.<sup>54</sup>

This shaft was the first of four to be drilled, although the original conceptual design called for five shafts for the original two-level repository.<sup>55</sup> Two of the shafts would be for waste transport—the TRU shaft and the RH (remote-handled) shaft. Two more would be for ventilation exhaust—the mine storage ventilation shaft and the mine construction shaft. The fifth shaft would have been for personnel and mine materials, equipment, and ventilation intake. The drilling of the second shaft began in December 1981 and was completed in March of 1982.

Drilling of the SPDV ventilation and secondary egress shaft started on December 24, 1981, and was completed at a depth of 2196 feet on March 10, 1982. The Exhaust Shaft was constructed in two phases over a 16-month period. The first phase was the up-ream drilling of a 6-foot-diameter pilot shaft followed by down-slashing to a final diameter of 14 feet. Shaft excavation began on September 22, 1983, with the drilling of a pilot hole and was completed on July 31, 1985.<sup>56</sup>



## Concerns about Brine Reservoirs

In June 1982, the DOE announced that, at the request of the state, another hole would be drilled in search of brine deposits. WIPP Project Manager Joseph McGough said that the underground chambers planned for storing radioactive wastes might be reconfigured to the south of the exploratory shaft to avoid possible brine proximity problems. The announcement was made in a joint news conference in Albuquerque with George Goldstein, head of New Mexico's Radioactive Waste Consultation Task Force. He had asked in late May that the underground storage chambers be built south instead of north of the central access shafts, already in place.<sup>57</sup>

As mentioned previously, the EEG regarded the presence of any pressurized brine reservoirs beneath the WIPP site as a hazard for the very long term, anticipating the time when administrative control over the site might be lost. Of the nine deep boreholes drilled within an eight-mile radius of the WIPP's central shaft, two had encountered brine reservoirs below the Salado salt. The first encounter was in 1975 at ERDA-6, as already described in Chapter 1. The second came in late 1981 as a result of the deepening of WIPP-12, which had originally been drilled in 1978. "A much larger reservoir was encountered...a mile to the north of the WIPP central shaft. After this second encounter, DOE, acting on [EEG's] recommendation and the state's request, agreed to build the repository to the south of the central shaft rather to the north."<sup>58</sup> Meanwhile, the new exploratory borehole, dubbed DOE-1, was completed in July at a depth of 4060 feet. This borehole explored the area south of the shaft in the region now being proposed for the waste rooms. Bill Jebb, resident DOE site manager, announced, "There is no indication of hydrogen sulfide or brine, and the core samples look very good."<sup>59</sup> The subterranean conditions indicated by the deepening of WIPP-12 and the drilling of DOE-1 resulted in the DOE's decision, originally requested by George Goldstein, to reconfigure the site of the underground tunnels to the south.

The critics of the WIPP project were not convinced by the geologic evidence demonstrated by the WIPP-12 core samplings and by a series of flow tests at the borehole. It had been expected that some 1.5 million gallons of brine would flow out of the borehole during the tests, but Joseph McGough said that one million gallons would probably be the extent of the flow. Robert Neill of EEG commented that "the quantity of brine that is being flowed is less than was expected." But the significance of that would not be known until all the figures necessary to calculate the volume of the brine reservoir were available. "It's obviously better than if it was six times more than you expected," Neill observed. In addition to the flow test, Sandia sent samples of brine to Oak Ridge National Laboratory in Tennessee for chemical analysis. That analysis would determine the relative age of the brine—the older the brine, the less likely it was to pose a threat to the integrity of the planned storage facility. Chemical analysis of the water from WIPP-12 had showed it was chemically different from the brine found in ERDA-6. "That would [have suggested] the brine reservoirs tapped by the two wells are not connected," added

Neill. Which would reduce the probability that a large network of interconnected brine reservoirs might exist under the project site.<sup>60</sup>

Citizens Opposed to Nuclear Dumping in New Mexico, a group of Las Cruces residents opposed to WIPP, called for “a full disclosure” of the facts about the brine and hydrogen-sulfide problems at the site. Isabelle Burns, spokesperson for the group, cited newspaper articles that said DOE officials were considering moving the repository to another site south of the present location. Bill Jebb, DOE’s WIPP site manager, verified that the location of the underground tunnels was going to be moved but denied this was an indication that the problems were more severe than the public was being led to believe. “We knew this area had hydrogen sulfide gas—mining operations have hit it before,” averred Jebb. “But it’s not accurate that there is more of a situation here than we’re telling about—our actions in the field prove that wrong.”<sup>61</sup>

But New Mexico’s Radioactive Waste Consultation Task Force, headed by George Goldstein, was pressing Sandia for information on the brine situation. At a WIPP program review meeting on May 5, 1981, Wendell Weart commented:

After we make our statement to the Task Force, EEG is going to be asked to make a written report addressing the issues. They have people assigned to assemble the facts and present them in an understandable way—and some of the people they have putting that together aren’t very well versed in the problems and are having a great deal of difficulty in tackling it...I have been talking with them...but they do not feel they can ask us to review their work because they wish to remain independent of us which I think is proper; but they do have a difficult position to fill not having anyone who is as knowledgeable as either the Roger Anderson group [from the University of New Mexico] or us....one of the things they would like to see is a deep hole into one of these two areas...because deep dissolution is very much a concern to them....They are interested in brine reservoirs which goes along with the deep [dissolution] business.<sup>62</sup>

Dennis Powers at the same meeting observed that EEG had stated that ten out of sixty wells had hit brine reservoirs. “I thought that would be a one time statement [we] made to the EEG...a year ago—but it is being repeated to the point now that the inference is all you have to do is throw a dart at the map and one out of six wells will produce brine. This bothers me a great deal since the map was originally drawn the size and shape just to include the brine reservoirs in the Castile.”<sup>63</sup>

In a 1983 report, Wendell Weart summarized the evidence regarding brine reservoirs. Extensive studies had established that brine reservoirs were only present in Castile structures—a correlation shown by 13 separate drillholes. And their presence was observed only in the upper anhydrites of the Castile Formation. If the source of brine was the Capitan, the brine reservoirs were subsequently isolated from the Capitan and have been in a stagnant condition for at least several hundred thousand years. The absence of Castile deformation at WIPP made the presence of a brine reservoir unlikely although it was “virtually impossible to prove this.” The report concluded: “Brine reservoirs are not likely to occur at the site now

or in the near geologic future. If they should occur, they will not interact with WIPP except through human intrusion and the consequences of this (unlikely) occurrence are not unacceptable....The WIPP site is qualified with respect to the criterion on tectonic stability (and brine reservoir) considerations.”<sup>64</sup>

In the meantime, as part of a major cost-cutting effort, DOE directed that the five shafts called for in the original design be reduced to three. This was a consequence of the decision to not use WIPP as a repository for high-level waste. The design now would include the following three shafts: the Salt-Handling Shaft, the Waste Shaft, and the Air Intake Shaft.<sup>65</sup> The original shaft drilled on October 24, 1981, became the Air Intake Shaft. The Salt-Handling Shaft was drilled in early 1982 and tunnels were excavated connecting it to the Air Intake Shaft. The pilot hole for the Waste Shaft was drilled in 1983. Subsequent operational experiences showed the necessity for a fourth Exhaust Shaft, which was started in 1988.<sup>66</sup>

## **The Army Corps of Engineers Takes Over Construction**

DOE had limited capabilities in engineering and construction work, and needed to hire a “vast array” of personnel to complete the \$2.1 billion project on schedule. DOE had already contracted with private firms such as Westinghouse for technical expertise and Bechtel Corporation for design, but construction management emerged as a major concern. In November 1980, DOE began looking for an organization capable of delivering the project within budget and on schedule. Preliminary talks were initiated with the Albuquerque District of the US Army Corps of Engineers, whose representatives were “only too glad” to undertake the challenge of managing the work at the WIPP site. Although the Corps of Engineers had never undertaken a project of this type before, it understood the scope of the work and had trained personnel who had participated in large-scale construction projects in New Mexico: at Kirtland AFB in Albuquerque, White Sands Missile Range, and the Cochiti and Santa Rosa dams.<sup>67</sup>

In June 1982, the DOE and the Corps of Engineers finalized an agreement to begin construction at the WIPP site. The Corps’ Albuquerque District could then add new positions, allowing several former employees of various Corps Districts to return from projects in Saudi Arabia. There they had worked under difficult desert conditions and experienced isolated working environments, which would serve them well in their new assignments in southeastern New Mexico. The Corps achieved a sharp reduction in costs, an acceleration of the overall completion date by almost two years to October 1986, and managed the most serious threat to construction—lost man-hours and fatalities, even though by mid-1985, sadly, one employee had died on the job.<sup>68</sup> The Corps completed the construction of the main shaft in 1981 and began excavating the underground storage and test rooms soon after. The most difficult task underground would be expanding the existing 6-foot shaft to a diameter of 21 feet and excavation of storage tunnels and drifts by a Japanese firm, Ohbayashi-Gumi of Tokyo, with offices in San Francisco. The work



View of the site in 1982. At the right can be seen the tower over the exploratory shaft. On the left is the air exhaust shaft under construction. It is next to the salt pile where the salt brought up from the excavated shafts and tunnels is stored.

would entail the excavation of about 120,000 tons of salt for the creation of an experimental test area at the WIPP site.<sup>69</sup> When Ohbayashi's bid was accepted in 1983, the second-place bidder, Thyssen Mining and Construction, Inc., sued on the grounds of Ohbayashi's "unfitness" to perform the work. The U.S. District Court in Albuquerque upheld the Corps' selection procedures for the contractor, although it did note that the Corps "could have made more thorough inquiry" into Ohbayashi's shaft-sinking experience, even though the Japanese firm's main task was to mine storage tunnels and drifts. Once Ohbayashi completed its underground work, the remaining tasks for the Corps would be above ground, notably construction of the Waste-Handling Building, scheduled for completion in early 1987.<sup>70</sup>

Despite expectations that one of the underground test rooms, a “round room,” would be difficult to excavate to Sandia’s specifications, Ohbayashi took it as a challenge and developed a technique to excavate the room, providing a product that exceeded Sandia’s expectations.

## **Another Agreement Between New Mexico and DOE**

Early in 1983 New Mexico achieved a stronger position regarding the WIPP project as a result of additional agreements with DOE growing out of the Consultation and Cooperation agreement finalized on July 1, 1981. That agreement was a two-part pact: the first dealt with technical on-site issues, still unfinished in 1983. The state primarily was asking DOE to prove the geologic adequacy of the salt beds near Carlsbad. This was being accomplished by DOE submission of technical data to state officials. George Goldstein said that by January 1983 about half the material had been submitted. The key off-site issues were settled in early 1983. It is here that Goldstein felt the state had come out “in a much stronger position” than it had before. One issue dealt with emergency preparedness in case of an accident during shipment of the radioactive wastes. The DOE agreed to partially fund and help train a team to respond to any emergencies. Another issue was liability in case of accident. New Mexico feared it might be vulnerable to damage or neglect suits. But the agreement released New Mexico from liability questions, stipulating that the federal Price-Anderson Act would provide up to \$560 million in coverage. “The real clincher,” which Goldstein still regarded with “a degree of amazement,” was the agreement for “independent monitoring.” This gave the state the right to monitor all nuclear waste transportation; get pre-notification of routing (and even a say as to which state routes would be used); and, most important, go to a site where waste was being produced and monitor its packaging and shipment. And what if the state health official doing the monitoring believed a load was poorly packaged? “We wouldn’t have any course but to fix it up,” responded Dave Jackson, DOE information officer. He added that the DOE already observed NRC and Department of Transportation standards for all waste shipments and that previously other states had monitored federal nuclear waste shipments, thus making the DOE-New Mexico monitoring agreement “quite not the milestone precedent-setter” Goldstein said it was. But Jackson agreed with Goldstein that no state-federal monitoring agreement had ever been as comprehensive or formalized as this one.<sup>71</sup>

## **Construction Proceeds at WIPP and Opposition Grows**

In February 1983, the DOE filed a land-withdrawal application in preparation for the construction of the WIPP repository. Joseph McGough, the WIPP project manager, said that the expected decision to go ahead with the project would be announced by DOE in a Site Validation Report. He said no decision would be final until the report was issued, expected to be by April 1, which would be followed by 60 days of state and public review and another 30 days for the DOE to respond to



any concerns. Two years previously, the DOE had requested the withdrawal of the same 8960 acres. This request had been rejected said Bureau of Land Management (BLM) spokesman John Gumert because “they were just starting to work, hadn’t drilled yet.”<sup>72</sup>

When the Site Validation Report was issued in early April 1985, the WIPP site was a “cluster of buildings and trailers—which resemble[d] a small potash mining operation more than what would be the nation’s first low-level nuclear repository.” The main entrance to the mine was a nine-passenger elevator that took people and equipment 2150 feet below the surface, dropping 500 feet a minute, and which carried eight tons of mined salt on the return trip to the surface. The three trucks, one mining machine, and assorted other equipment used in the mining operation were disassembled on the surface and lowered piece by piece in the small elevator and reassembled underground. The extant 6-foot-diameter ventilation shaft was



The WIPP site as it appeared in February 1985.

planned to be expanded to a diameter of 19 feet (the size of the current operable passage) to meet the requirements for the waste emplacement shaft. A third ventilation shaft was also scheduled to be drilled. The walls of one underground room were “dotted with circular gadgets and wires that measure[d] the Earth’s movement. The data [were then] sent to a computer-filled cabinet, also underground.”<sup>73</sup>

Meanwhile, Toney Anaya, the new governor (1983–1986), insisted on “meaningful” public hearings on the DOE’s final report.<sup>74</sup> Anaya was an outspoken opponent of WIPP and mistrustful of the DOE’s assurances that the repository would never be used for high-level waste. His suspicions were aroused upon learning that several underground experimental rooms were slated for tests involving simulated high-level radioactive defense waste.

In May 1983, the EEG declared that a “20-mile island of geologic stability exists around the proposed [WIPP].” This pronouncement was made by Robert Neill at a two-day meeting in mid May at Carlsbad of 40 geologists, hydrologists, and other scientists from the USGS, several universities, Sandia, the NRC, DOE, and the National Academy of Sciences’s panel on WIPP. They had gathered there to make final reports and sort out arguments on the proposed \$2.1 billion project. EEG was in the process of responding to the Site Validation Report which would be submitted by DOE as a report to the governor. Neill said his group had used a “modeling technique to determine the safety and geologic stability of the site.” He said the technique included “reconstructing” the past, and then attempting to construct a future of the site validity. Neill pointed out that the “burden of proof” for the safety and integrity of the site rested with the DOE, which had developed the criteria for the project with assistance from Sandia. “The EEG thinks the criteria is [*sic*] pretty good, and we haven’t come up with anything better yet,” he concluded.<sup>75</sup>

The impending go-ahead for the final phases of construction at the WIPP site gladdened some and inspired dark foreboding in others. Carlsbad Mayor Walter Gerrels announced that the project would provide up to 700 jobs during the construction phase and 350 to 400 permanent positions thereafter. “I think this is certainly going to help the economy in our community,” declared Gerrels. “There will be other spinoff-type opportunities that local service people can benefit from and there will be some families coming to Carlsbad who will need housing and other things.”<sup>76</sup> However, at least one Carlsbad family was so upset at the prospect of radioactive waste shipments being trucked through the town that they decided to leave. “My husband, daughter, and I are leaving town,” announced Betty Sabo at a BLM public hearing on the proposal to withdraw land for the WIPP. “We have already made arrangements and bought land in Oregon, and we are going where there will be no risk of [radioactive waste] transportation through our community.”<sup>77</sup>

At the beginning of June 1983, Governor Toney Anaya delivered a “strongly worded message” to the DOE in which he came out against immediate

construction of the proposed WIPP. "At the present time, the state of New Mexico cannot cooperate with any decision by DOE to let contracts for facility construction or to begin actual construction for the WIPP project," Anaya said in a letter to DOE's Albuquerque manager, Raymond Romatowski. And he continued that if the federal agency did not agree to New Mexico's demands, the state could go to court or the political arena.<sup>78</sup>

Anaya's statement followed on the heels of a warning from Robert McNeill, New Mexico's Secretary of Health and Environment, that the state would oppose full construction of the WIPP project "unless it receive[d] a written guarantee that the facility [would] never be used to store high-level nuclear waste." Explaining that WIPP's eventual use remained too "open-ended," he told federal officials that the state was "unalterably opposed to any further change in the WIPP mission."<sup>79</sup>

Finally, in July 1983, the DOE announced that construction of the WIPP site would begin in mid-September. Addressing Governor Anaya's earlier call for a delay in construction, WIPP project manager Joseph McGough said he was "confident" DOE had "adequately addressed" Governor Anaya's concerns about the radioactive waste repository. The governor, who was notified in letters from DOE Secretary Donald Hodel and DOE Albuquerque Operations Manager Romatowski, called their response "superficial, though not unexpected."<sup>80</sup>

Preliminary construction had begun in 1981–1982 with the sinking of two vertical shafts. The new construction would entail enlarging the existing 6-foot shaft to a diameter of 19 feet to be used for the transportation of wastes, over which a waste-handling building would eventually be erected. A new 14-foot-diameter shaft would be sunk for ventilation, while an existing 10-foot-diameter shaft would continue to be used for removing salt and carrying workers. In addition, a short rail spur would be constructed to the site, a highway extended, and a water pipeline for drinking water and fire protection would be built.<sup>81</sup> To obtain potable water for use at the site, a 31-mile-long pipeline had to be constructed to bring water from an existing Carlsbad well field in the "Cap Rock" region north of the site.

In August 1983, state officials met with DOE representatives to negotiate a written agreement that would "more narrowly" define the mission of the WIPP repository. After a three-hour session in Albuquerque, the state's Health and Environment Secretary, Robert McNeill, expressed confidence that "nagging" state worries about WIPP's ultimate purpose were close to being resolved. McNeill reiterated issues that Governor Anaya wanted settled before full construction began in September. Those issues included placing an upper dosage limit on the transuranic radioactive waste permanently stored in the WIPP salt beds, restricting the amount of high-level waste radioactive waste temporarily stored there for experiments, allowing the Nuclear Regulatory Commission to participate in designing those experiments, and adopting storage standards that would eventually be issued by the Environmental Protection Agency.<sup>82</sup>

## WIPP Revealed to the Media

The DOE, sensitive to some of their critics' allegations that they had withheld critical information from the public about the WIPP site, invited a group of local newspeople to a tour of the underground facility in September 1983. The six reporters made the 2200-foot descent in a "small cage" that held six visitors or nine workers, "who must be really close friends." The "ear-popping, metal-grating" trip took a few minutes to reach the underground facility. They saw the two parallel main tunnels that had been ground out of the salt, as had several of the connecting drifts. In one area, office space had been carved out, with the walls and ceilings painted white and fluorescent lights brightening the darkness. In the drifts, however, overhead lights barely mitigated the darkness. Most of the illumination came from high-intensity mining lights strapped to hard hats worn by workers, managers, and press alike. Also strapped next to the light's battery was a self-contained breathing apparatus. Safety officers assured the visitors that only a "slim chance" existed that the breathing devices would be needed. Near the underground offices, an area of one wall had been marked off according to the various minerals contained in the salt bed. Each stratum was visible, and the explanations were helped by giving names to the various red, yellow, and brown patterns embedded in the walls of the drifts.<sup>83</sup>

Eric McCrossen, an editorial writer for the *Albuquerque Journal*, described his experience:

Once you have toured the Waste Isolation Pilot Project under construction 26 miles east of [Carlsbad], it is difficult to understand the controversy that has surrounded it. And it is easier to believe the support the project appears to have from area residents.<sup>84</sup>

Descending in the elevator cage, he observed that the first 850 feet of the vertical shaft was lined with steel to hold back earth and sand. Below that point, the shaft was cut through salt that had been compacted by nature into solid rock. Unlike many underground mines, the humidity was "extremely" low. And one of the considerations in selecting the Los Medanos site was the absence of moisture in the 3000-foot-thick salt bed. McCrossen saw that a "number of tunnels—drifts—had been cut out of the salt by a continuous mining machine." This machine had been disassembled on the surface and brought below ground pieces at a time and then reassembled. Soon a second machine would be in service. The mined salt was brought to the surface and dumped in piles. It would be returned below ground as needed to backfill over the waste containers. In time, through natural compression of the salt, the waste materials that eventually would be placed in the WIPP would be encapsulated by the salt.<sup>85</sup>

The DOE and Westinghouse, which has the Management and Operations contract at WIPP, were conducting an ongoing public relations program to explain the project and respond to questions about its safety. Carlsbad civic leaders met

interested individuals from throughout the world to explain the project and indicate their support for WIPP and the jobs it was bringing to their community. Fred Gurney, Westinghouse manager for site operations, pointed out that more than 2000 visitors had been through the site by late 1983. Mayor Walter Gerrels of Carlsbad stated that the DOE had been responsive to community concerns and that “we’re comfortable with the project.” McCrossen summed up his feelings:

Opponents of the project appear to fall into two classifications: those who don’t understand the project or its safety or those who oppose nuclear technology in all forms. An understanding of WIPP might ease their concerns—at least about WIPP itself.<sup>86</sup>

The plans called for about 200 acres to be mined into rooms 13 feet high, 33 feet wide, and 300 feet long. Each room would provide about 30,175 cubic feet of storage space. The total project eventually would have approximately 1.8 million cubic feet of storage space. Each room would be separated by 100 feet of solid rock salt. The rooms that had been opened thus far were heavily instrumented to determine movement (creep) of the walls, ceiling, and floor. The instruments were connected to a computer on the surface. The extreme pressure at that depth pushes the walls inward at a rate of two to three inches a year. Four rooms more than 3000 feet from the waste isolation storage area were planned to be used to test storage of high-level waste materials such as spent nuclear fuel rods, but before those tests were conducted, tests simulating the fuel rods would be run.<sup>87</sup>

## Underground Experiments

“A very large” in situ program was implemented at the site, according to Wendell Weart. “At one time we had 5000 data channels recording continuously. We had a large contingent of field test people down there to help us implement and record [these] data.”<sup>88</sup> These early studies were under the operational direction of Chris Christensen and the implementation of the tests was the responsibility of Jim McIlmoyle who headed up Sandia’s field test group. Christensen functioned as the field coordinator: “...he was the guy who took the scientific specifications for a test and translated them into actually being implemented in the field,” Weart indicated. “And because we had to have a lot of mining and drilling support, this was provided by Westinghouse, and at the peak we probably had a Westinghouse crew dedicated to underground tests [consisting] of about 40 people and probably about a dozen Sandia or Sandia contractor people. This was for us a fairly large effort.”<sup>88</sup>

Weart described the scope of the activities in the underground experimental rooms, characterizing them as probably being on a scale larger than anything that had ever been carried out, at the time and up to the present:

[In] each big experimental room complex, we would erect an underground shed and then in there we would put data acquisition, electronics—we’d multiplex all that information and send it up to a surface recording station over a single cable. So we had a big recording station on the

surface [and] we'd record all this information continuously on tape. Acquisition of gages, the acquisition of data, the recording, any manipulation that had to be done of the data...[was all] very thoroughly and carefully documented, and it [has] served us in good stead today when the [Environmental Protection Agency] now wants to see our process and how we arrived at all these conclusions that we did.<sup>89</sup>

The initial mining for the Preliminary Design Validation (SPDV) was done in 1981–82. Basically, that was a tunnel about a mile north-south and one mile east-west, as well as the design validation rooms—a set of four rooms that reproduced the design of the repository. “That was done by mid 1983,” said Weart, “and we were installing a lot of our initial experiments in 1983 and on through about 1985. Many of these experiments lasted for anywhere from five to a dozen years.”<sup>90</sup>

Many of the experiments centered on thermomechanical aspects because at this time there was still a great deal of interest in bedded salt for a high-level waste repository, not at WIPP but at Deaf Smith County, Texas. Consequently many of the WIPP experiments simulated the effects that could be expected from emplacement of heat-generating high-level wastes from DOE waste facilities, such as Savannah River Site. In fact, Sandia technicians under the direction of Darrell Munson designed experiments that simulated in every way possible, except for radioactivity, the thermal and geometric effects of a defense high-level waste repository. This was achieved by having a center room with two outboard rooms that provided the right thermal and excavation boundary conditions. “These experiments gave us a lot of very valuable information on how a heated facility would respond,” explained Weart. “Eventually, of course, people lost interest in that because of the decision not to use the Deaf Smith County bedded salt site.”:

But nevertheless it gave us in WIPP a lot of valuable information even though the WIPP repository sees no significant thermal effects because of the nature of our waste. What it did was allow us to test our codes and our understanding for strains that were much greater than we could ever get in the period of time we had available to us if we just used ambient temperature. [This is] because the heating greatly speeds up the strain in the salt, allows the rooms to deform much faster, and gives us large strains in a few years that would take decades to get if we relied upon just the ambient temperature deformation of the salt. So we got a lot of very useful information even though the simulation for defense waste turned out not to be of as much interest as at one time it was thought.<sup>91</sup>

Many experiments were also carried out with materials to observe the interaction between the salt and potential brine environments with various canister and vitrified glass waste materials. One experiment that generated widespread international attention, and attracted foreign participants, was conducted by Martin Molecke of Sandia. This was the Materials Interface Interaction Test (MIIT) in early 1986. Savannah River Site, which was going to produce defense high-level waste (DHLW), contacted Molecke, because they did not have an adequate test facility for their DHLW. “Savannah River Laboratory contacted me about cooperative in situ testing in WIPP,” Molecke recalled. “And the test really ballooned because there [was] a lot of interest [on the part] of a lot of different



countries. We wound up with seven countries—France, Britain, Japan, the US, Germany, Belgium, Canada—all providing non-radioactive simulated waste forms and proposed canister metals for distinct testing in heated boreholes in brine at the WIPP. These tests provided an identical, in situ test environment for all waste and waste package materials included, for both comparative and modeling (waste leaching and materials interactions) purposes. We emplaced over 50 complex test assemblies in 1986, kept them going for five years, with periodic samplings, the busiest times being between 1986 and 1988. These tests led to two international workshops, one in 1988 in France and the last one in 1992 in Belgium.”<sup>92</sup>

## **The Recurring Brine Controversy**

While construction of the underground tunnels and test rooms and the surface buildings proceeded through 1984 and 1985, questions continued to be raised



By September 1985, the Waste-Handling Building (left) was well along.

about ground water under the WIPP site. This was quantified in part by several brine seepage experiments conducted by Jim Nowak between 1985 and 1986, in several of the simulated defense high-level waste test boreholes. In 1986, a report by the EEG urged that more studies be undertaken to ensure that water would not invade the underground storage chamber of the WIPP. James Channell, an EEG scientist and author of the report, said it was possible that water could carry radioactive wastes stored at WIPP into the outside world. While Channell believed that the chances of such a release were small, he said more study of the water-bearing Rustler aquifer characteristics was “essential.” Sandia scientists disagreed with him on the probability that a breach could connect the Rustler Formation overlying the Salado Formation with the storage chamber 1300 feet below. Channell commented that the Sandians “don’t believe that this problem exists at the site itself and that it wouldn’t be very important if it did.” He said a key question that had to be answered was the extent of karst formations within the Rustler. (Karst formations are hollow areas within rock that could speed the transport of contaminated water to the external environment.)<sup>93</sup>

Al Lappin, at the time Sandia’s manager for site characterization at WIPP, said two well-pumping tests done in the summer of 1985 and another one scheduled for the summer of 1986, should answer that question, and criticized the EEG for giving “too much weight” to the Rustler breach scenario. He said it was possible that budget cuts might delay some of the tests. “There is no guarantee that everything will be finished,” said Lappin. “DOE’s first priority remains having WIPP ready to receive wastes by 1988—completing the tests sought by the state comes second.”<sup>94</sup>

## **The Environmental Evaluation Group as Watchdog (1986-1988)**

In 1986 EEG had twelve full-time employees working on scientific issues involving the WIPP. Director Bob Neill said, “We’re the only full-time group looking over DOE’s [and Sandia’s] shoulder.” He took credit for pointing out that the TRUPACT containers violated DOE’s own regulations and convincing DOE to strengthen the containers by eliminating the single-wall (or containment) design and opting for double containment. DOE also announced in June 1986 that it would do away with planned vents in the container’s door that would have allowed air in or out while filtering radioactive particles, a Sandia design that EEG also opposed. Earlier research by EEG led to a shift of WIPP waste rooms to the south, away from a brine reservoir that might have posed a hazard to the stored wastes at the original site. The WIPP project manager, W.R. “Randy” Cooper, praised EEG’s work as “professional” but added that he felt “frustrated” by the time required to respond to the group’s inquiries. “Some are warranted, some are not—that’s immaterial,” said Cooper. “We have a responsibility to respond. From my perspective, they’re a burden.”<sup>95</sup>

Another EEG study, released in November 1986, suggested that the risk of future contamination of the Pecos River from a radioactive waste repository might be



greater than the DOE supposed. This was because ground water in the Rustler Formation above the 2150-foot-deep WIPP underground rooms might be recharged by water moving vertically through the formation, and not simply recovering since the last ice age as the DOE believed. Such water movement might increase the probabilities that future drilling into the waste site would contaminate ground-water flows to the Pecos River. These assertions were made by Jenny Chapman, a hydrogeologist for EEG. Her report contradicted DOE studies carried out by Sandia that had tentatively concluded that the water, found in certain zones of the Rustler Formation approximately 1500 feet above the WIPP underground chambers, had not been replaced or “recharged” by rainfall in thousands of years. Chapman called those conclusions “premature and incorrect.” She said her own comparison of the WIPP site water with water from other nearby sites showed similar characteristics, suggesting that the WIPP water was “just as fresh” as most other ground water in southeastern New Mexico. “If there is recharge...the water movement would be faster,” stated Chapman, “and therefore the consequences [of breaching the WIPP site] would be worse.” She acknowledged the higher risk would only be important if someone were to drill into the WIPP site, perhaps for oil, at some time in the distant future not realizing the radioactive waste had been buried there.<sup>96</sup>

Within one day, the DOE criticized the Chapman study describing it as “too limited” to contradict its own studies on ground-water movement in the Rustler Formation. DOE spokesman Ben McCarty said in a prepared statement that

these water beds have been the subject of extensive examination for more than 10 years by the DOE. The state study apparently addresses only one facet of a complex geologic and hydrologic system that cannot possibly be understood without considering all aspects of the geohydrology in context. [We] have never contended the ground water system is stagnant and [we have] done other, more direct studies that indicate that ground water flow does in fact occur. The DOE does, however, conclude from its broad-based studies that current ground water recharge at WIPP is limited in quantity. That, however, has only a small effect on how rapidly the water is moving over the site, since the system continues to drain. The water-bearing beds are only one link in the chain of barriers that would reduce the chance of any radioactive contamination of the environment.<sup>97</sup>

Sandia initiated an extensive program of hydrologic studies of the Rustler aquifer, which continued through 1999. More sophisticated three-dimensional modeling shows that the potential vertical recharge does not accelerate transport of radionuclides from the site.

Thus, by constant monitoring and questioning of the scientific studies being conducted at the WIPP site, the EEG was fulfilling its charter to function as an autonomous federally funded agency but attached to the New Mexico state government. And these issues were aired out in the local press, mainly in Albuquerque’s two newspapers, the morning *Journal* and the afternoon *Tribune*.

“From the very beginning we wanted to keep it [EEG] as a technical review group,” recalled Bob Neill. “I made the decision also not to get into socioeconomic issues, really legal issues.” And continuing:

Perhaps in hindsight some of the social issues are the more important concerns of why society wants to establish more rigorous standards, let's say, from radioactive material in the environment than for medical applications. The levels of acceptability are quite different for these, and ionizing radiation is ionizing radiation—it doesn't matter whether it comes from a plutonium atom or it comes from an x-ray used to see if someone has a broken arm or for a chest x-ray for detection of pulmonary diseases. We focused, as you might expect, on some of the geological issues.

We're not a regulatory agency, we never had any authority to say do this or do that. As an oversight agency you lack that clout. You can convince people to do it, you can cajole them or otherwise convince them to do things. Now, the role of Sandia has been truly an independent scientific organization not only charged by DOE...to do these analyses but they've done it objectively and independently.<sup>98</sup>

Even though the EEG's research was relied upon by anti-WIPP groups, the watchdog agency's objectivity was not above suspicion in some quarters. In 1984 Richard Hayes Phillips, a postgraduate student at the University of Oregon, wrote a research paper with the title “WIPP Cover-Up: Geopolitics in the Land of Enchantment” that purported to document “the systematic avoidance, disregard, or suppression of geologic evidence unfavorable to the WIPP project.”<sup>99</sup> He implicated EEG in this cover-up because, while it “functions as a New Mexico State agency, it is funded entirely by the...DOE. If EEG were to oppose the WIPP project, then EEG might be terminated by DOE. This is a powerful incentive for EEG to see that serious doubts about the geological integrity of the WIPP site never find their way into official EEG publications.”<sup>100</sup> The allegations were published in *The Santa Fe New Mexican* and were of sufficient concern that Sandia Vice President Everett Beckner wrote to the University of Oregon expressing his “concern regarding Mr. Phillips' representation of the work.” He offered to send a Sandia scientist to present a colloquium “or other discussions” regarding WIPP.<sup>101</sup> Mel Merritt reviewed the paper and opined: “Basically this is a piece of yellow journalism. It has all the stigmata: allegations of conspiracy; misunderstood, selected, and distorted facts; indications of personal pique; and argumenta ad hominem that approach libel. The allegation of conspiracy is self-evident in the title of the paper.”<sup>102</sup> Neill called Phillips' allegations “without merit or substance.”<sup>103</sup>

## **A New Governor, a Freshman Congressman, and the Land Withdrawal Bill Controversy**

For the WIPP project, the year 1987 continued to bear out the old Chinese curse, “May you live in interesting times.” To begin with, the environmentalist and anti-WIPP Democratic governor Toney Anaya's term ended, and he was replaced by the pro-WIPP Republican Garrey Carruthers (1987-1990). And New Mexico also had a

new U.S. representative, Democrat Bill Richardson\* who was responsive to his constituents' environmental concerns over WIPP. Interestingly, the rest of the state's congressional delegation—Senator Pete Domenici (R), Senator Jeff Bingaman (D), Representative Manuel Lujan (R), and Representative Joe Skeen (R)—was by this time generally supportive of the WIPP project.

The first sign of dissension within New Mexico's congressional delegation surfaced with the drafting of the WIPP Land Withdrawal bill that would transfer 10,240 acres of federal and state land to the DOE for use as a permanent site for the radioactive waste repository. Bill Richardson said the bill should include "an assurance" that DOE would help fund an alternative highway from Los Alamos to Santa Fe [in Richardson's district] as part of "a safe transportation route when low-level waste [*sic*, actually TRU wastes] shipments from Los Alamos commence." Other members of the New Mexico delegation said they shared Richardson's goal of obtaining DOE funds to help build the alternative road out of Los Alamos plus a Santa Fe bypass but were reluctant to "tack it on" the Land Withdrawal bill. Joe Skeen said, "If we're going to get into building roads, we're going to get mired down." The cities of Roswell and Hobbs, both in Skeen's district, were also asking for bypasses to keep future waste shipments out of their city limits. Senators Bingaman and Domenici both said they wanted federal funds for the road but didn't want to use the bill to get the funds. Bingaman had played the lead role in 1981, while Attorney General, in putting together New Mexico's Consultation and Cooperation Agreement with the DOE, which stipulated that the government would spend \$58 million improving 206 miles of existing state roads over which TRU wastes would be transported to WIPP.<sup>104</sup>

Four members of the New Mexico congressional delegation agreed on the details of the Land Withdrawal bill they planned to introduce on May 20, 1987. Representative Richardson refused to cosponsor the bill because he said the state did not have a "firm commitment" to obtaining \$190 million in road funds. Rather than try to authorize funding for roads in the Land Withdrawal bill, the other four delegation members decided to let the state pursue its efforts to get the funds added to the six-year-old stipulated agreement it had signed with DOE.<sup>105</sup>

As WIPP prepared to receive its first shipment of waste in 1999, bypasses had been built in Santa Fe, Roswell, and Carlsbad. Major upgrades were completed on the highway from I-40 to Carlsbad using WIPP funds.

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\* Bill Richardson was elected in November 1982 and served in the 98th-103rd Congresses (1982-1996). President Bill Clinton appointed him as United Nations ambassador in February 1997. Richardson served in this position until July 31, 1998, when the Senate confirmed him as Secretary of Energy.

## Another Agreement and Reflections on Regulations

The regulatory quagmire in which WIPP increasingly found itself was illustrated by a legal snag that could affect the state's being able to enforce part of its agreement with DOE, which it had signed on July 30, 1987. DOE and New Mexico agreed to give the state the protections it had demanded for the transportation, storage, and perpetual security of radioactive defense wastes taken to WIPP. New Mexico Attorney General Hal Stratton announced that the agreement ended a long-running dispute over the following six items:

- (1) Mining: DOE agreed to take steps to prohibit mining for oil, gas, potash or other minerals above the WIPP site.
- (2) Transportation: DOE promised that containers used to ship waste to WIPP must be certified by the Nuclear Regulatory Commission. State officials argued the NRC standards were tougher than DOE's, and would lessen the risk of releasing radioactivity in truck or train accidents.
- (3) Testing: DOE agreed to comply with most U.S. Environmental Protection Agency standards for nuclear waste disposal before the opening of WIPP. Certain standards that required extensive measurements, however, would not have to be met until WIPP was more than 15 percent full. Among other things, the EPA standards require that a disposal system be designed to contain projected releases of radioactivity for 10,000 years.
- (4) Barriers: DOE agreed to meet EPA standards for natural and man-made barriers to seal off radioactive wastes after disposal. These barriers would include backfill and plugs and seals in shafts and drill holes.
- (5) Salt disposal: Salt mined to open WIPP's underground tunnels would have to be disposed of "in an environmentally acceptable" manner after WIPP closed in an estimated 25 years.
- (6) Brine: Because DOE had agreed in 1981 to move the underground storage area south of the original site to avoid underground brine deposits, the Stratton agreement required DOE to give the state 45 days' notice before making any plans to develop storage space to the north—an "unlikely event," according to the Attorney General.<sup>106</sup>

The legal snag referred to above involved EPA regulations spelling out steps for the safe disposal and permanent storage of radioactive wastes. A federal appeals court in Boston had thrown out the EPA regulations in early July, meaning they no longer were binding. Don Hancock, director of the Southwest Research and Information Center (SRIC) and dean of WIPP activist opponents, said, "Legally

speaking, it's hard to bind anyone to standards that don't exist. DOE might say it could comply voluntarily with the old standards. But the state's historical experience with WIPP is that their promises have not always been kept...EPA probably will have to develop new regulations, but it's unlikely they could be put into effect before the scheduled opening time for WIPP of October 1988." However, Stratton and a DOE attorney concurred that the snag posed "no serious problem."<sup>107</sup>

Wendell Weart reflected on the increasingly complex regulatory requirements as they developed over the years:

There are many regulations that impact us and when we started, of course, on WIPP we had no regulatory guidance at all, there was no EPA standard on repositories. We adopted our own views of what were good site selection criteria, in fact, in many areas we were more stringent than the criteria now [1996]. Perhaps fortunately not knowing what an appropriate regulation period should be, we said let's use ten half lives of Pu239, which is almost a quarter of a million years. Nowadays, of course, EPA has settled on 10,000 years, a much shorter period of time. What this has done, of course, is make for a fairly robust site in many respects. Another federal standard, 40 CFR 194, is the criteria for how to interpret the basic repository standard, 40 CFR 191. And they've also come up with guidance on how to interpret the criteria to interpret the standard. Well, as a result of these things, we find that there have been changes in direction from what we were doing to interpret the 191 standard. So we now find ourselves in a position of having to do a lot of additional things in our analysis and in our performance assessment that really make our job much more difficult. To show that we are in compliance, we have had to develop new information and analyses and frequently we needed to develop it at the eleventh hour. So that's how institutional changes and regulations can affect you. These repositories take so long in their development and implementation that we find ourselves having to address standards that we didn't even think of when we started.<sup>108</sup>

## **A Commercial Repository Proposed**

A somewhat surprising example of the sea change in the state government's attitude toward the WIPP project and the issue of radioactive waste repositories in general was Governor Carruthers's endorsement of a proposal to build an additional repository in southeastern New Mexico for high-level defense waste and spent fuel from commercial nuclear power generating plants. Some business people in Carlsbad and Hobbs had told Carruthers that such a project would boost the area's economy. The proposed burial site would be separate from the unfinished WIPP. At this time, the DOE had chosen sites in Nevada, Texas, and Washington for detailed studies to determine their suitability for disposing of high-level wastes and spent fuel deep underground. Carruthers's statement raised additional fears among environmentalists that WIPP would eventually accept commercial spent fuel that was lying in pools at nuclear plants around the country, awaiting a final resting place. However, Carruthers opposed using WIPP for commercial waste. He said the proposed site "would be a new one and would have to go through the same process as WIPP" to be built.<sup>109</sup>

The governor also favored allowing experiments involving high-level waste to proceed at WIPP. “The experiments will show what conditions are safe for permanent burial of such wastes,” he said. Carruthers was replying to a question at a press conference about Bill Richardson’s opposition to the recent WIPP agreement between New Mexico and DOE. Richardson objected to a provision that allowed some waste to be stored at WIPP before all U.S. Environmental Protection Agency regulations were met. Both Carruthers and U.S. Representative Joe Skeen said Richardson earlier had agreed to allow some wastes to be placed at WIPP before the EPA regulations were fully met. Richardson had agreed with the state and with other members of New Mexico’s congressional delegation to seek \$190 million in additional federal highway funds for the state, and now he contended the amount was inadequate. Denying he was criticizing his colleague, Skeen said Richardson was threatening to delay WIPP by taking advantage of a “very exploitative political issue...Richardson is dredging up questions about WIPP’s risk that were settled in the 1970s and early 1980s.”<sup>110</sup>

Richardson defended his WIPP position in a column published in the *Albuquerque Journal*. Among his points were the following:

There’s a point in politics where partisanship ends and public interest takes over. We have reached that point in the controversy surrounding the [WIPP] near Carlsbad....with all due respect to both the governor and the attorney general, the principles outlined in [the agreement between the state and DOE] do not satisfy the very real needs of a state which is about to become the first permanent home to much of the nation’s nuclear waste....key federal officials in a federal process, who have broad constituencies from Farmington to Hobbs, were not just underrepresented, they were not represented at all....By selectively excluding some members of the state’s congressional delegation, the New Mexicans we serve were also excluded....Unanswered questions plague this effort. How do we balance the clearly experimental nature of the WIPP project with the need to comply with the strictest, safest EPA standards? How do we ensure that by acquiescing to high level waste experiments at WIPP, we are not inadvertently enticing the nation to store all of its high level commercial waste at Project WIPP?...What assurances do we have that DOE will not change the safety rules again, further down the road?<sup>111</sup>

Meanwhile, also in 1987, the idea of building a high-level waste repository in southeastern New Mexico appeared to be “gaining momentum.” Support for the project seemed to coincide with the appearance of two anonymous “white papers” that circulated among state officials, the congressional delegation, and DOE. The white papers suggested that “a commercial site could be built 10 miles south and slightly east of WIPP at a location previously considered for WIPP. In return, New Mexico could get not only the Supercollider, but also \$100 million annually under an incentive bill proposed in the U.S. Senate.” Commented Governor Carruthers, “I must say it was a fairly well-crafted piece, obviously done by someone who was knowledgeable [of the research performed at the WIPP site].” In September, a New Mexico legislative committee meeting in Carlsbad unanimously passed a resolution asking the U.S. government to consider Eddy County for the new repository, already the home to the still unopened WIPP. Carruthers helped matters along by saying, “Personally, I think that New Mexico—if they so desire in that area—merits an opportunity at least to be considered.” Bill Richardson believed the DOE was

behind the idea. He called the Carlsbad gathering a “freight train” and complained the scheme was “picking up steam because the governor has indicated that he is receptive to the idea.” Said Richardson, “It’s unfortunate this is happening without adequate public input and debate.”<sup>112</sup>

However, within days Carruthers backtracked when he did not receive support from the congressional delegation for a high-level waste repository. The strongest reservations were expressed by Senator Jeff Bingaman: “The high-level waste project [in Nevada, Texas, and Washington] has gone too far for us to come in at this late date.” Decidedly unenthusiastic responses also came from Senator Domenici, Representatives Skeen and Lujan, and of course, Bill Richardson.<sup>113</sup> Finally, a “disappointed” Carruthers abandoned his campaign to have the Delaware Basin considered for a commercial nuclear waste disposal facility. Citing opposition from Senator Domenici, Carruthers wrote to Carlsbad Mayor Bob Forrest, a chief promoter of the idea, that it would be “inappropriate” for the state to pursue the spent fuel repository project.<sup>114</sup>

The high-level waste (HLW) heated tests were terminated because the U.S. Congress decided to focus all HLW repository work on Yucca Mountain at the Nevada Test Site, thereby removing interest in salt-related studies. Sandia was allowed to bring these tests to a technically adequate conclusion and to report all results and interpretations.

The debate resurfaced shortly after when Robert M. Jefferson, who was the first manager of Sandia’s Transportation Technology Center in the late 1970s and at this time a private consultant, admitted to being “one of three authors” of the two “white papers” after a reporter for *The Dallas Morning News* revealed his connection. “The other two authors sought to remain anonymous to protect their jobs,” Jefferson said, adding that he wrote the papers because he did not want New Mexico to lose the repository just because political leaders were afraid to stand up for it. “The governor did and got his fingers slapped,” he said.<sup>115</sup>

## **The Environmental Evaluation Group Under Attack**

In December 1987, the Carruthers administration turned its attention to the Environmental Evaluation Group whose contract was coming up for renewal. The EEG had been established in 1979 as part of a state agreement with DOE which paid for the oversight group through a contract with the New Mexico Institute of Mining and Technology in Socorro. The current contract between the state and DOE was due to expire in March 1989. The salaries of the five Santa Fe-based scientists were frozen and Carruthers ordered them to relocate to Carlsbad. A memo from the governor also urged EEG to stop using an “anti-WIPP” scientific consultant.

In view of the governor's actions, four of the five scientists wrote to Carruthers asking about EEG's future (the fifth, Director Bob Neill, was out of town when the EEG scientists' memo was written without his knowledge). The scientists' memo read in part: "Because of the decision to move EEG to Carlsbad, we are each individually considering whether to move with EEG...or to pursue other opportunities....An important criterion in our individual decisions will be our assessment of the support that is present from this administration." Kirkland Jones, deputy director of the state's Environmental Improvement Division and Carruthers's advisor on WIPP legal issues, replied to the EEG memo saying the state "will continue to be committed to an independent scientific evaluation" of WIPP but did not say whether the administration would seek to keep the scientists' jobs. Earlier memos from Jones recommended that EEG stop using UNM geologist Roger Anderson because of his participation in the Committee to Make WIPP Safe, an anti-WIPP group led by George Goldstein, a former state Health and Environment Secretary. Lokesh Chaturvedi, an EEG engineering geologist, replied that Anderson's work was "highly regarded....We have worked with three different administrations, and we were never told who we could or could not hire as consultants."<sup>116</sup>

In a news conference, Carruthers said, "It is a mystery to me how you can evaluate an environment on a day-to-day basis from Santa Fe." However, state legislators representing northern New Mexico criticized the governor's actions regarding the EEG. Max Coll, representing Santa Fe, said EEG needed to be in the Santa Fe-Albuquerque area because it provided state and federal policymakers with objective information about the construction and operation of the WIPP site. He said the scientists could be subjected to "pressure and intimidation" in Carlsbad, where WIPP and related projects were a major economic factor. Another EEG environmental engineer, Jim Channell, told the legislators that Carlsbad "can be considered a hostile environment for people critical of WIPP."<sup>117</sup>

EEG's problematic status stretched out into 1988. In March, Bob Neill submitted his resignation. This prompted Senators Bingaman and Domenici to introduce a bill in Congress which would remove the group from Governor Carruthers's administration. The bill transferred EEG from the Health and Environment Department to the New Mexico Institute of Mining and Technology in Socorro. On the same day that Bingaman and Domenici introduced their bill, Carruthers promised to make the transfer administratively, even before Congress voted. Several of the EEG staff, including Neill, rescinded their resignations except for one scientist who had been on leave of absence from Los Alamos National Laboratory.<sup>118</sup>

## Surf's Up

With the status of EEG settled, WIPP's ups and downs continued in other issues, such as brine seepage. This water is different from that of the brine pockets discussed above, being left behind by the brine sea that deposited the salt beds 225 million years ago. It was suggested that enough brine might seep into the



waste storage areas to form a pressurized slurry of brine and radioactive waste. If some future hapless oil or mineral explorer should drill into the slurry, enough liquefied waste could gush up to the surface to violate EPA standards (even if the agency no longer existed). Sandia's studies suggested no slurry would form, but reliable measurements on the seepage question were only now becoming available and the research community had not had time to analyze the studies and reach a consensus on what, if any, threat the brine posed. The recent fear was that brine might seep into the rooms faster than the salt creep could close them. Wendell Weart said early studies indicated the salt contained between 0.1 percent and 0.5 percent water by weight. But more recent tests had shown some samples containing more clay had up to 3 percent water, with an average of about 1 percent. Also, prior to WIPP it had been assumed that the brine was trapped inside the salt crystals. This brine would migrate to the repository primarily if attracted by a heat source, such as high-level waste. But once there was underground access, "we found immediately that brine seepage doesn't require a heat source," explained Weart.

John Bredehoeft, a hydrologist with the U.S. Geological Survey and a member of the National Academy of Sciences's WIPP Review Panel (another WIPP oversight group in addition to EEG), early on recognized the significance of the brine flow. "The salt is full of brine," he said in a 1988 phone interview. "The more you look,



John Trever is the editorial cartoonist for the *Albuquerque Journal*. This 1988 cartoon is typical of the mordant humor that he brought to his observations of the controversies surrounding WIPP.

the more you see...that brine is moving into the facility. It changes your vision of what the facility will be.” Robert Neill of EEG said, “the brine flow essentially will be in a race with the salt creep. The inflow will continue as long as the pressure in the salt is higher than in the repository. If the rooms close quickly, equalizing the pressure, the brine shouldn’t be a problem.” However, if the brine accumulated faster than the rooms could close, the result would be a slurry of brine and radioactive waste pressurized by the salt creep, gas generated by radioactive decay, and bacterial decomposition of organic matter.<sup>119</sup>

Such arcane technical discussions became increasingly more esoteric to the general public which read about them in carefully written, balanced articles in the *Albuquerque Journal*. The brine question was taken up by groups opposed to the opening of WIPP, at this time scheduled for October 1988. A group of eleven New Mexico scientists, including the controversial University of New Mexico geologist, Roger Anderson, testified before the National Academy of Sciences’s WIPP Panel in February 1988. They expressed concern about brine seepage and urged a delay in burying radioactive waste there. Anderson said the self-appointed group, which called itself the Scientists Review Panel on WIPP, believed waste disposal should be “put on hold” until the full implications of the brine seepage finding “are understood.” He said that the discovery of brine seepage into the mine “had refuted the original assumption that the beds are dry.”<sup>120</sup>

The National Academy of Sciences’s WIPP review panel concluded that seepage of water into the WIPP “probably isn’t a serious problem” but also recommended that only the amount of radioactive waste necessary for research should be placed underground during WIPP’s first five years of operation. Konrad Krauskopf, the Panel chairman, said the Panel members were “unconvinced” by arguments that a pressurized, radioactive slurry would accumulate inside the Carlsbad repository, threatening ground water or any person unlucky enough to drill into it. But he said that only around 25,000 barrels of TRU waste should be placed in WIPP during the first five years, instead of the planned 125,000. Wendell Weart concurred with this figure as being adequate to resolve the many issues regarding the site’s suitability. Twenty-five thousand drums would be enough to fill four storage rooms, which were 300 feet long, 33 feet wide, and 13 feet high.<sup>121</sup>

## **The Land Withdrawal Bill Dies**

In the meantime, the WIPP Land Withdrawal legislation was still pending in Congress because of the disagreements among the New Mexico delegation. The WIPP Land Withdrawal Bill was finally “declared dead” for the 1988 legislative session by four members of the New Mexico congressional delegation after the fifth member, Bill Richardson, called off any further talks to resolve differences with his colleagues. The differences were still the same ones over adhering to EPA standards, building a bypass road around Santa Fe, and proposed high-level radioactive waste experiments at WIPP.<sup>122</sup>

However, Senator Domenici took issue with the claim that the opening of WIPP had been delayed by the failure of Congress to pass the bill. He blamed DOE because it “hasn’t complied with all its requirements,” Domenici charged in a letter to Energy Secretary John Herrington. He also said that “under the best of circumstances,” WIPP would not be able to open until late March or early April 1988. Among the actions DOE failed to complete were a final safety analysis review, certification of TRUPACT-II by the NRC, and failure to formulate a plan for experiments to be conducted at WIPP that would be acceptable to EEG and the National Academy of Sciences.<sup>123</sup>

Naturally, pro and anti-WIPP groups saw the demise of the Land Withdrawal bill and the role of Bill Richardson differently. Environmentalists cheered the demise of the legislation. Concerned Citizens for Nuclear Safety, a Santa Fe anti-nuclear group, issued a news release stating that “Rep. Richardson has proven to be the only member of the New Mexico delegation to exercise conscience and responsibility on behalf of all New Mexicans.” And Carlsbad Mayor Robert Forrest countered: “I’m disappointed in him. I can’t believe one person could stand in the way like that.”<sup>124</sup>

WIPP supporters could at least take heart in the progress already achieved toward completion of the repository. The fourth vertical shaft had been drilled in May 1988, so by the end of the year four shafts from the surface provided access between the repository surface buildings and the underground excavations. Drifts (underground roadways) linked the shafts to the waste disposal area which would consist (they would be mined when needed in the future) of eight panels—rectangular sections off the main haulageways. Each panel would be subdivided into seven rectangular rooms excavated between access drifts (corridors that provide passage to the individual disposal rooms, bounded by 30.5-meter-wide pillars on each side).<sup>125</sup>

Mere words cannot convey the impressiveness of the engineering achievement that is WIPP. Nine miles of tunnels carved in a salt formation, most lighted and ventilated, with experiments humming away in many of the underground chambers. So, in August 1988, DOE officials decided to charter a passenger plane and fly 30 Santa Feans, including city council members, reporters, and Los Alamos Lab representatives to see WIPP at close hand. They landed in Carlsbad and were bused 25 miles to the WIPP site. Top DOE officials led a five-hour tour of surface and underground facilities, including a golf cart journey through some of the nine miles of tunnels. The Santa Fe group was “impressed with the wizardry of WIPP’s high-tech waste handling operations and underground experiments....elected officials also praised the safety precautions that so far [had] made WIPP’s employee accident record far superior to the mining industry’s.” The visit, however, did not succeed in convincing all Santa Fe city officials that WIPP was safe or allay their fears of accidents in Santa Fe involving trucks taking radioactive waste to the WIPP site. For instance, none of the four Santa Fe city council members said they would

back away from a resolution the city council had passed seeking transportation safeguards before wastes were trucked through Santa Fe. “I’m still a little concerned about the transportation,” said city council member Phil Griego. “I’ve yet to see a demonstration of waste being transported. That will make or break whether I’m in favor of having nuclear waste transported through our city.” Another councilor, Peter Goodwin, compared WIPP to a James Bond movie: “It’s a stage set—it’s very slick.”<sup>126</sup>



The WIPP site in June 1986 showing the Waste Handling Building almost completed.

## Notes

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# Chapter 3

## WAITING FOR WIPP (1989 – 1999)

*The difficulties increase the nearer one comes to one's goal*  
Johann Wolfgang von Goethe, *The Sorrows of Young Werther: Elective Affinities*

*Have you ever noticed that anytime anything good is said, it's always, "Sandia scientists today discovered," but when it's bad, "the DOE said today..."*  
James E. Bickel, DOE WIPP manager<sup>1</sup>

In 1989 the nation inaugurated a new president, George Bush, and was on the verge of the final decade of the 20<sup>th</sup> Century. The only certainty about WIPP at the beginning of the year was that it was still not on the verge of opening. It had not received a small, mostly symbolic, shipment of transuranic wastes from Idaho by October 1988, as DOE had been optimistically announcing through most of that year. The main reason WIPP did not open was the failure of the New Mexico congressional delegation to agree among themselves on Land Withdrawal legislation to send to Congress. And one reason they did not agree was because of Representative Bill Richardson's insistence that WIPP be in full compliance with Environmental Protection Agency (EPA) standards before receiving any radioactive waste. The next target date of August 1989 was already being described as "overly optimistic" by a DOE official in February of that year.<sup>2</sup>

The WIPP site was officially completed by 1990, although construction had essentially been finished in 1988 and large-scale non-nuclear underground experiments had been conducted since 1984. The WIPP surface facilities consist of 234,000 square feet of permanent buildings including support buildings and a waste-handling building. Four shafts connect them to the underground complex. The mined underground operations area consists of nearly 10 million cubic feet of excavation, almost nine linear miles of tunnels. The waste-handling building consists of two sections: one for contact-handled TRU waste (CH-TRU) and the other for remote-handled TRU waste (RH-TRU). CH-TRU waste consists of waste drums and boxes that do not emanate high enough radiation to prevent contact handling. RH-TRU waste has significant radiation emission (>200 mr/hr) and must be handled remotely by workers.<sup>3</sup> An impressive facility, the only one quite like it in the world, WIPP elicited admiration from its supporters. But most of its opponents remained unconvinced. For instance, Bill Richardson, after touring WIPP in early 1989, declared, "Based on what I've seen today, I still say we need full EPA compliance before WIPP can open."<sup>4</sup>





Dignitaries at the dedication of the Waste-Handling Building in 1988. Left to right, Ray Romatowski, manager of DOE/ALO, Governor Garrey Carruthers of New Mexico, Representative Joe Skeen, and Bob Forrest, mayor of Carlsbad.

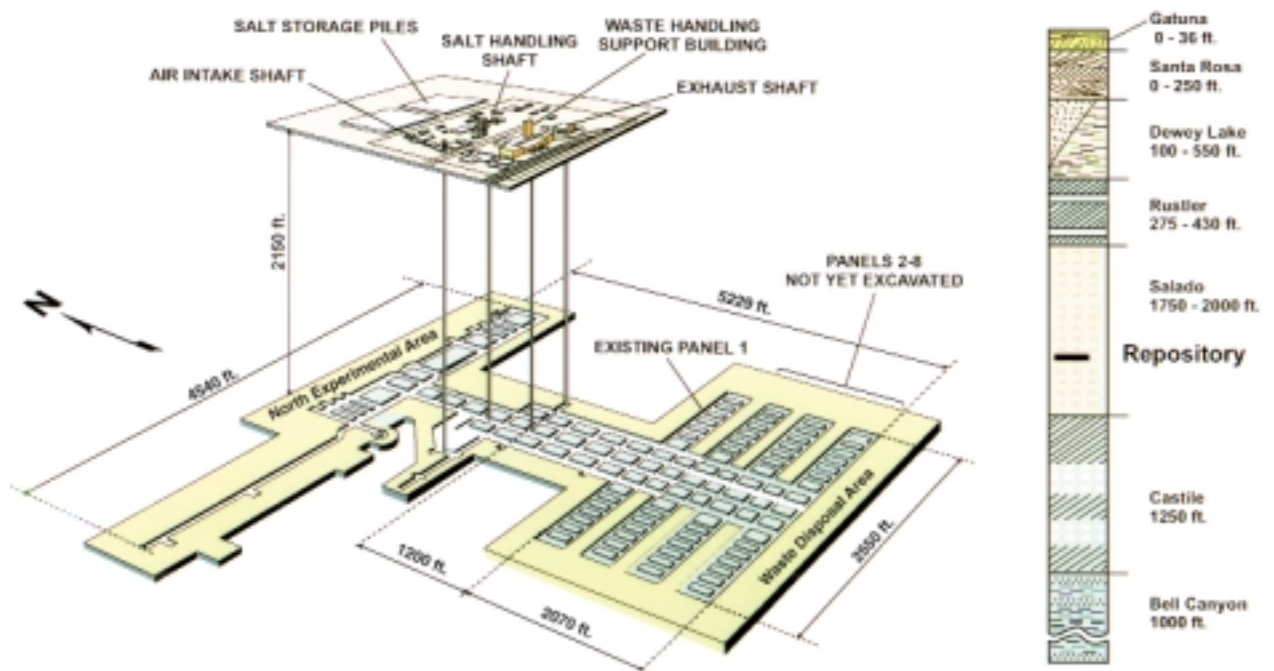
## A New Secretary of Energy

On January 12, 1989, President Bush swore in Admiral James D. Watkins as Secretary of Energy. Formerly chief of naval operations until his retirement in 1986, Watkins was a nuclear engineer and had served in Admiral Hyman Rickover's nuclear-powered submarine program. In announcing the nomination while he was still President-elect, Bush observed that both he and Watkins believed that "protecting the environment...is not at all inconsistent with advancing both energy security and national security needs." As to the DOE, Watkins commented:

There is an urgent need to effect a significant change in its deeply imbedded thirty-five-year culture [which has] evolved from such heavy emphasis on achieving production goals, made within an atmosphere of collegial secrecy, that problems relating to safety, health and the environment have not only been backlogged to intolerable levels but, in effect, hidden from public view until recently.<sup>5</sup>

## WIPP at Fourteen Years

At the end of 1989, in an interview with the Sandia employee newspaper, Wendell Weart offered his assessment of WIPP from the perspective of his fourteen-year involvement as manager of the project. During that time, he had seen the project grow from a largely scientific investigation (“...the most minute study of a salt deposit in history...”) to a full-blown exercise in operations in which scientists had come to play a supporting role. Weart said he felt confident that WIPP was a safe repository for TRU wastes but “proving its safety in quantitative terms” to the EPA standards would require “considerable work over the next few years.” Sandia scientists had learned that, geologically and hydrologically, salt “provides as favorable an environment as we had hoped it would going into this work.” The site-characterization work found no natural geologic or hydrologic processes that could breach the site for millions of years. However, as they got underground and observed the actual salt behavior, Sandia scientists had encountered some “surprises.” Weart observed that the “creep [movement] rate was more rapid than we had thought. But that is favorable in that it seals the wastes even sooner.”<sup>6</sup> Brine seepage was more than expected, but “intensive investigation” showed it was a “small enough quantity”—less than one percent of the original room volume—that it would not lead to the formation of a waste slurry as predicted by WIPP critics.<sup>7</sup>



An artist's conception of the WIPP layout.



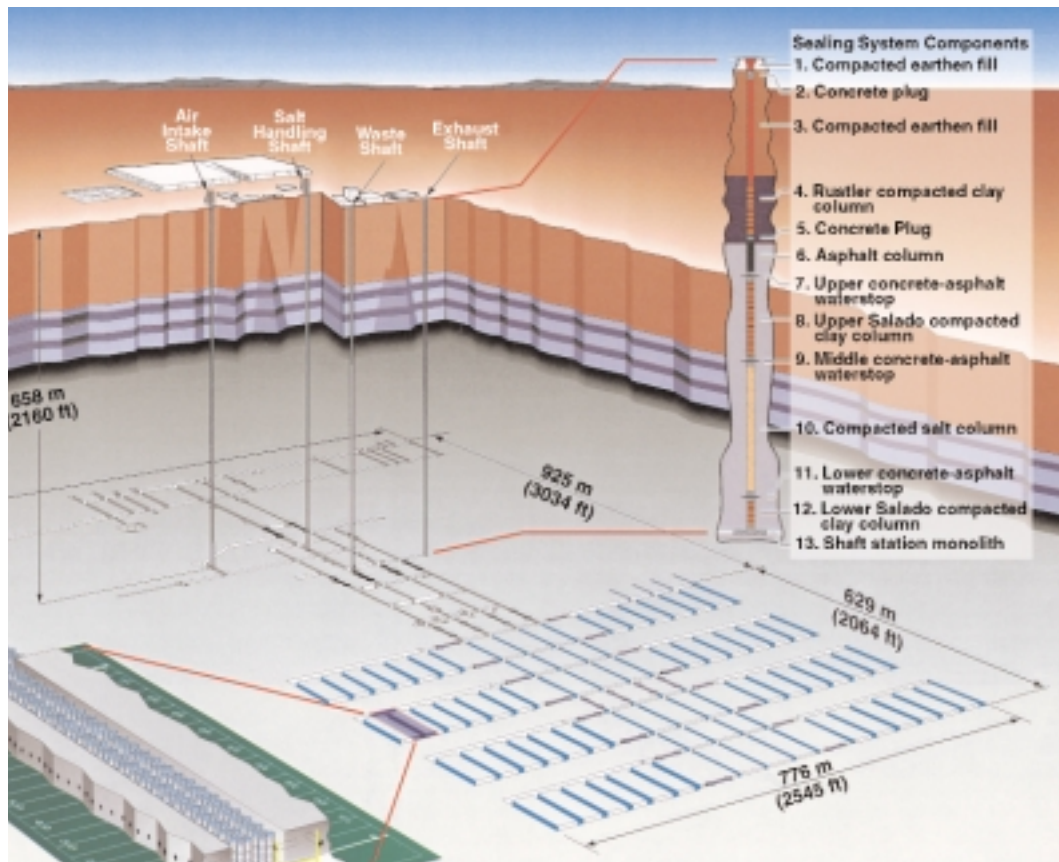
As to WIPP's opening, Weart quoted Energy Secretary-designate Watkins as saying that the repository would not open before July 1990. The date was unsure because of "a number of issues." First, the DOE had to obtain a permit to place mixed wastes (containing both radioactive and hazardous materials) in the repository. Another issue was the need to withdraw land for WIPP by either Congress enacting the required legislation or having the land administratively withdrawn by the Department of the Interior for use by DOE. Also, a Safety Analysis Report, describing facility operations, had to be completed and the Supplemental Environmental Impact Statement (SEIS) had to be finalized. The draft version of the SEIS was published in spring 1989 and was the subject of public hearings during the summer. According to the requirements of the National Environmental Policy Act, the DOE had to respond in a final SEIS to all comments made at the hearings, after which Admiral Watkins could issue a record of decision on how to proceed with WIPP. The state of New Mexico also had to formally designate the routes to be used for transporting the waste within the state.

Weart referred to a National Academy of Sciences expert panel that emphasized the need to begin scientific experiments using actual transuranic wastes. "These studies will improve our understanding of how the underground environment will interact with large-scale waste emplacements," he said, "and are separate from the DOE/Westinghouse plan to use wastes to demonstrate the operating capabilities of WIPP." These projected tests were first to start in October 1988, and were originally to fill Panel 1.<sup>8</sup>

## **Sandia's Underground WIPP Experiments**

Scientific studies using actual TRU wastes were, however, only proposed in 1989 and, as described later in this chapter, would not be carried out. But Sandia began an extensive series of non-radioactive experiments soon after the first underground excavations were completed.

At the northern end of the underground complex was a cluster of rooms for experiments in which Sandia had been studying various aspects of waste isolation in salt since 1984 and some of which continued until 1995. These experiments, initially designed and justified in 1982 (Chapter 2), focused on (1) the interaction of the waste containers with the repository environment, under the direction of Martin Molecke, (2) the salt's structural/thermal response, under the direction of Darrell Munson, and (3) ways to seal shafts and drifts, under the direction of John Stormont. The data being obtained from the laboratory experiments already in place were helping to shape full-scale experiments that were planned for the next five years. Among these experiments was the Materials Interface Interactions Test (MIIT) under the management of Sandia's Martin Molecke and already described in Chapter 2.



Artist's conception of WIPP and the surrounding geology.

The MIIT test was a simulated high-level nuclear waste study to understand how various canister metals and vitrified (glass) materials from seven nations would react in the hot, corrosive environment of a salt storage room. In 1989, MIIT was in a “maintenance mode” in which glasses and metals would be sampled and analyzed again at the five-year mark. In the interim, they would remain in heated boreholes (which Sandia scientists had filled with brine) in the salt floor of Room J where the temperature was consistently 105° F.

Four underground test rooms were dedicated to the waste package interaction programs, all managed by Martin Molecke. Among these, located in Room J, was a drum test for the simulated contact-handled transuranic wastes that would be stored in the repository. In this test, drums—some backfilled with bentonite,\* salt, or pure salt backfill—were stacked in a dry, but humid atmosphere. Some drums were actually placed in a saturated brine bath prepared by Sandia. Samples of the brine bath were taken regularly to analyze chemical reactions between brine and barrels. These packaging tests were actually overtests which, by increasing the temperature above that actually expected underground, would accelerate the reaction processes, allowing better modeling of reaction rates in a shorter time. These tests lasted from 1985 to 1990.

\* Bentonite is a clay that absorbs water and radionuclides



The entry drift to the seven rooms of Panel 1, which were mined for disposal. This area is in the south side of the underground facility.



In another room, designated T, still more waste-package-materials tests were under way. To predict the integrity and potential retrievability of contact-handled waste drums during the five-year test period, 240 drums were stacked in two rooms against a rigid steel-and-concrete reinforced wall in 1989. The rooms were heavily instrumented with gages to measure pressure on the drums during closure. Then the rooms were backfilled—one with crushed salt and the other with a salt-bentonite clay mixture. The wall of the room, the tunnel wall, was allowed to creep inward, applying pressure to the backfilled drums. Remote-handled (RH-TRU) waste canisters, electrically heated to about twice the maximum thermal input of actual RH-TRU waste, were placed, backfilled, and instrumented in the walls, or ribs, of Room T. The waste canisters were monitored for closure rates, temperature, and pressure; these tests were evaluated for five years. The post-test recovery and analysis of these tests were never carried out, ostensibly because of safety issues in reentering these “old” rooms, primarily due to the danger of roof collapse.



Martin Molecke in the test room where interactions between heat-generating simulated waste and salt were measured. Quartz-rod heaters were placed inside canisters which were then placed in the floor compartments and sealed. The canisters were 10 feet long by 2 feet in diameter.

In 1985, electrically heated waste package canisters had been installed in Rooms A-1 and B to simulate defense high-level wastes. Stainless steel canisters with a thick steel overpack and non-corrosive titanium canisters were evaluated in this test. The containers from Room B were removed in 1988 after three years of testing, but the rooms continued to provide valuable data on closure. Because these were among the first rooms mined in the experimental area, they were being watched to understand deformation. It was in these still-instrumented rooms, where closures of 25 to 30 inches had been recorded, that cracks were beginning to form in the surrounding salt and eventually room collapse occurred in the unsupported rooms. Because of the termination of the high-level waste program for salt, funding was not available for recovery of the A Room canister tests.



Darryl Munson shown standing in a test room that simulated as closely as possible the conditions of actual disposal for Savannah River defense high-level waste.

At this point, it was expected that once the entire repository was full of radioactive waste, shafts and drifts would be sealed, usually with crushed salt, to guarantee long-term isolation of the wastes. The salt would eventually reconsolidate to its original density and strength. In some cases, water-absorbing bentonite would be added to the salt to help handle brine and other potential liquid problems. Salt for making the seals was available from nearby surface piles of salt taken out of the mines during excavation. An adobe-block-making machine (adapted from a demonstration machine at the New Mexico State Fair) located underground formed the crushed salt into blocks. Current plans do not rely on salt backfill in the waste rooms, but compacted salt will form a key part of the shaft seals.

Among the experiments relating to seals and plugs was one in Room L-2 where three 35-foot-deep, 38-inch-diameter shafts accommodated a small-scale experiment containing shaft-seal materials and instruments to measure pressures, temperature, and other conditions under which the seals would have to function. Observers could look into the lighted, sealed shafts through thick, clear plastic covers. The salt blocks used in this experiment were compacted to 80 percent of the density of intact-formation salt. Part of the effort here was to demonstrate that low-permeability seals could be placed in a shaft. Workers set the blocks in place and carefully filled cracks with a powdered bentonite. Permeability measurements for the seals were obtained periodically.

In Room D, small horizontal seals were being tested to determine the sealing efficacy of concrete and blocks made of salt and salt-bentonite mixtures. In theory, brine or other liquids would swell the sandwiched mix between the blocks to reduce permeability. In some experiments, brine was deliberately being introduced to test this idea. Other barrier experiments examined combinations of salt and bentonite, salt and concrete, to pure bentonite or salt barriers.

Sandia scientists had calculated the expected results of almost all major tests in the WIPP. These calculations were used to set instrument ranges, to offer an opportunity for peer review of the experimental concepts, and eventually to serve as a test of predictive capabilities. Accuracy in calculating how the salt beds would react to mining and the heat from radioactive wastes was critical to predicting the project's overall success and disposal-system performance over a 10,000-year period.

Two other experiments incorporating creep and brine inflow were being conducted in Rooms L-4 and Q, respectively. The latter test (completed in August 1989) was called the Large-Scale Brine Inflow and was underway in Room Q. This was the definitive test on brine seepage designed in conjunction with National Academy of Sciences members who were particularly interested in this phenomenon. This room was a 10-foot-diameter, 350-foot-long cylinder bored into the same formation where the waste rooms would eventually be situated.



The cylindrical shape was important because it was believed that a round room would reduce the cracking that develops in the disturbed zone surrounding excavations. Reduced cracking would permit more accurate assessment of the amount of brine approaching Room Q at different points. The pressure of brine in the pores of the salt varied at different distances from the mine wall.



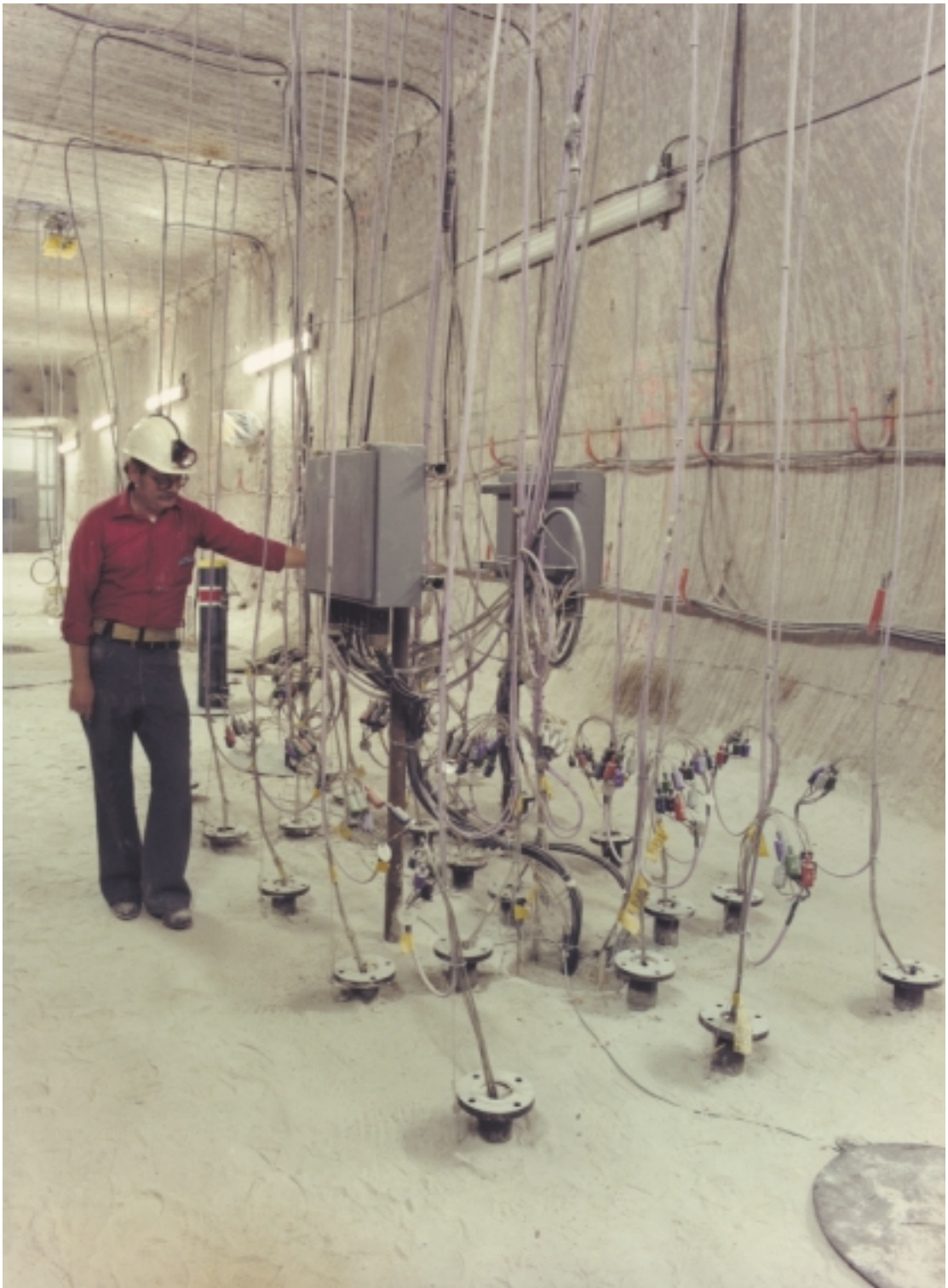
View of an experimental room of the disposal area. Shown is the entry and bulkhead seal to the brine seepage test room.

Permeability and pore pressure helped in understanding the response of the rock to excavation and the conditions under which the brine would begin to move.

The Small-Scale Brine Inflow test was a much smaller, but related, experiment in Room L-4. It entailed vacuum pumping of the 36-inch-diameter bore instrumented to measure creep, humidity, and temperature. The experiment sought to relate brine inflow to creep and, by pumping, it would be possible to see the brine, not readily visible in the larger-diameter bore. As with Room Q, instruments measured characteristics of the disturbed zone beyond the borehole to determine brine dynamics in the area.

One of the better-known thermal-structural interactions experiments, called Heated Pillar, could be found in the highly instrumented Room H, under the management of Darrell Munson. Here, miners had cut out a 118-foot-diameter room, leaving a 36-foot-diameter pillar of salt in the center into which





One of the several test rooms in which experiments were carried out to understand the thermal-mechanical properties of salt. Darryl Munson, in photo, was responsible for all rock mechanics experiments at WIPP.

measuring instruments (strain gages and thermocouples) were installed. Sheathed with a 6-inch-thick blanket of insulation, the pillar was heated to 70 degrees Celsius and measured to check for deformation. The closure of the room was also being checked; in eight years, vertical closure was about 11 inches, horizontal closure about 10 inches. The heating had appreciably accelerated the strain rate and provided more data than could be obtained at ambient temperature.<sup>9</sup>

An earlier criticism that Sandia's extensive test program intended to address came from Luther J. Carter, a writer on radioactive waste disposal policies. He said the findings for a high-level waste repository (not WIPP) pertaining to salt creep, salt cracking, and brine occurrences and migration being obtained by late 1985, "although incomplete and not well understood...seem[ed] compelling." Calculations done with theoretical models indicated a major problem in maintaining a capability for retrieving waste over several decades. The model indicated that by the end of the first 10 years, total salt creep in the 13-foot-high disposal room would be about 8 feet.

That is, in no more than a decade this chamber would lose almost half its original height: the floor, into which the canisters would be inserted in vertical holes, would heave up and the roof would creep down. The heat from radioactive decay hastens creep, but the "heat loading" used in the model was lower than the near-field temperatures that would be present in a repository for commercial spent fuel.<sup>10</sup>

At WIPP, a large (up to 4 inches wide), discontinuous but interconnected horizontal crack that occurred in an anhydrite bed several feet beneath the floor of Room T also was of concern beginning in late 1985. The cracking, caused by the stress relief in the floor, was subsequently found to extend along the room's entire 300-foot length and all the way across its 33-foot width.

In Carter's view, and again referring only to a high-level waste repository, the creep and cracking phenomena would complicate waste canister retrieval in several ways. The room in which canisters were vertically emplaced could only be kept open by periodic mining to raise the ceiling. But the canisters would move upward with the salt and their orientation could be a "confused jumble because of tiltings and deflections resulting from lateral creep, the presence of impurities, and the buckling of the repository floor."<sup>11</sup> Carter also referred to the complication that any voids around the canisters or emplacement sleeves would be occupied by a "hot and briny slurry, possibly under high pressure."<sup>12</sup> This scenario was rejected by the National Academy of Sciences WIPP panel in 1988 after a well-publicized public debate.<sup>13</sup> More evidence of cracks developed in 1989 when one of the engineers was having a hole drilled in Room 1 and detected air and dust coming out of other holes and cracks in the room, indicating there was a continuous fracture about 3 feet above the ceiling, according to Lokesh Chaturvedi of the EEG. "It



Once the drums of radioactive waste are stored in the permanent disposal area of the WIPP underground facility, salt creep over time will cover and entomb the drums thus preventing release of radioactivity.

posed dangers to workers who had equipment in the room, so the DOE decided to clear out the rooms...or have limited-access rooms,” he added.

Studies in the WIPP underground facilities through the 1980s showed that floor heave and ceiling instabilities are the natural consequence of drift closure of the excavations in salt. The floor displacement also caused large fractures in a layer of anhydrite five feet beneath the WIPP excavations. This anhydrite bed (known as Marker Bed 139) will fracture when the floor heaves; this is part of the expected behavior of room closure, and being less “plastic” will not heal as readily as the rest of the salt formation.

Because of its age, the floor in SPDV Room 1, Panel 1, was leveled several times in preparation for the bin tests. The ceiling failure, as anticipated and demonstrated in the same Room 1 and Room 2, could also pose a threat to bin experiments, and was addressed by a massive roof support system which would control roof fall indefinitely. Once WIPP is in full operation, neither floor nor



WIPP underground emergency vehicles

back stability will pose a concern since the excavated area will be used and isolated before the room closure becomes a threat.<sup>13</sup> When Sandia designed and initiated the WIPP in situ experiments, there was strong consideration in developing a high-level waste (HLW) repository in the bedded salt of Deaf Smith County, Texas. Since defense HLW would be a candidate for this repository, WIPP was used for investigating conditions apropos to this kind of waste emplacement. The two major phenomena of interest at these elevated temperature environments were accelerated salt creep and waste/waste package behavior. Conventional brine migration in a thermal gradient was also examined. Much useful information was obtained on all these behaviors but the program came to an abrupt end when Congress selected Yucca Mountain in Nevada as the only site to be characterized as a civilian repository site, and suspended all work on salt. The funding for defense HLW studies at WIPP immediately dried up and left WIPP with simulated defense HLW canisters still emplaced and unretrieved in Room A, although canisters had already been recovered from the other test room—Room B. Posttest evaluations, even for these canisters, however, were not completed due to the loss of program interest, and therefore funding, for salt-related studies. Much of these data and samples await a potential reawakening of interest in a salt repository for high-level waste.<sup>15</sup>



## Politics and Public Hearings

While the underground tests described above were being carried out at WIPP by Sandia personnel with Westinghouse involvement, the political battles over the controversial repository continued unabated through 1989. In 1988, Governor Cecil Andrus of Idaho, frustrated at the repeated postponements over the opening of WIPP, refused to accept further shipments of TRU waste into his state “until they [DOE] have a location where this waste will be stored.”<sup>16</sup> In 1989, Andrus modified his ban on waste shipments to the Idaho National Engineering Laboratory saying he was “concerned” about national security. In a Boise news conference, the governor said it was “essential” the Rocky Flats weapons plant not be forced to close because of his earlier decision to not accept nuclear waste from there. But the waste was accumulating at Rocky Flats in boxcars, and Andrus relented by allowing the DOE to transport two rail cars of waste a month from Rocky Flats to Idaho, “but only for six months.” After meeting with Governors Roy Romer of Colorado and Garrey Carruthers of New Mexico, Andrus declared that they had “bent over backward to ease this situation, but this is not Idaho’s and Colorado’s problem. This is a national problem that demands a national solution. The only acceptable solution is the timely opening of WIPP.”<sup>17</sup>

Meantime, Congressman Bill Richardson of New Mexico said he was “pleased” by Admiral James Watkins being “at the helm” of WIPP. He liked Watkins’s expertise in the nuclear field and his “accent on safety and better management and his promise to clean out the bad apples.” Richardson added, “I feel a WIPP bill can be worked out under his new leadership.”<sup>18</sup>

In April 1989, the DOE released its Draft Supplemental Environmental Impact Statement (DSEIS), an updating of the 1980 Final Environmental Impact Statement. One of its conclusions quickly picked up by the press was that DOE expected more people would be killed in transportation accidents involving the trucks carrying waste to WIPP than would ever die from radiation exposure emanating from the repository. The SEIS predicted between 0.000025 and 0.000026 latent cancer deaths per year to the public and 0.0053 to 0.0058 deaths to workers from radiation. By comparison, about 11 deaths were forecast from truck and rail accidents during WIPP’s 25-year operative phase. In May, DOE started holding public hearings around the country, including Albuquerque and Santa Fe, to receive public input on the study, and it would issue a final SEIS in August.<sup>19</sup>

The public hearings in Albuquerque and Santa Fe throughout June brought out angry denunciations of DOE and the WIPP. In Albuquerque, “speaker after speaker blasted the Energy Department for not doing enough to ensure that the nation’s first permanent nuclear waste repository near Carlsbad will be safe.” The day-long hearing attracted more than 80 people and included an

anti-WIPP demonstration by 30 people outside the Hilton Hotel, many of whom carried signs with such slogans as “Hell No, We Won’t Glow” and “Don’t WIPP Our Future.” The single issue seized on by most speakers was the DOE’s failure to meet EPA standards before its projected moving of plutonium-contaminated waste into the underground repository. “These standards are the only way to protect the public,” exclaimed George Goldstein, a former state Health and Environment Department secretary and at this time an anti-WIPP activist. Other issues brought up were medical training for doctors and equipment for hospitals along the WIPP route, a better delineation of the transportation routes in New Mexico, and the economic impacts on the state’s business and tourism once WIPP opened. Virtually the only support for WIPP came from about 30 Carlsbad residents who showed up at the hearing, including Mayor Bob Forrest who said, “I feel like this project is the best thing that ever happened to the city...in the last 15 years.”<sup>20</sup> Some members of the Carlsbad group said they were “spat upon” as they entered the hearing.<sup>21</sup>

In the midst of the hearings, ex-Governor Bruce King who had been in office when the WIPP project was started in the mid 1970s and was now running for governor again, accused DOE of breaking its promises to New Mexico. In the 1970s, he had been circumspectly supportive of WIPP, but now said his administration had expressed “major concerns” about the transportation routes to the WIPP site, as well as bypasses around New Mexico cities and training of emergency workers. “Ten years later, those areas of major concern still have not been resolved,” he said. “Transportation routes still have not been formally designated, highway upgrading and bypasses have not been completed, realistic transportation accident scenarios have not been developed and emergency response personnel have not been adequately trained and equipped.” King also added that WIPP should meet EPA standards before beginning a planned five-year test period.<sup>22</sup>

And as the hearings continued, most of the 60 people testifying agreed with King, albeit more colorfully. Albuquerque anti-nuclear activist Charles Hyder, who had attracted international attention in 1987 by fasting for 218 days in front of the White House in support of nuclear disarmament,<sup>23</sup> blasted the study as “a betrayal of the U.S. people, a perversion of the English language, a corruption of public funds....It’s outrageous and unacceptable.” State Senator Tom Rutherford said that much of the reason for public concern over WIPP was because “we just don’t trust the DOE anymore. Unfortunately the [SEIS] doesn’t give us any new reasons to trust them.” A few people sang songs and acted in skits to express their opposition to the repository. The panel of DOE officials heard the following lyrics, apparently minimally inspired by Dr. Seuss, from one opponent:

*You want to dump it on my head  
You want to dump it on my pregnant cat  
You want to dump it on my bed and say  
“Don’t worry today!”  
You think we don’t know where it’s at.”*

Another group sang a song called “Does DOE Love Me?” Those lyrics went, in part: “DOE loves me, this I know/’Cause the SEIS report tells me so.” To which Richard Marquez, DOE’s director of intergovernmental and external affairs, commented: “People are free to speak their allotted time on anything they want.”<sup>24</sup>

When the hearings moved to Santa Fe, the state capital, the “City Different” lived up to its reputation as both a self-styled artistic and New Age haven and a center of opposition to WIPP. Outside the Sweeney Convention Center on Marcy Street, the scene resembled a street festival as a stream of dancers, singers, poets, and storytellers took center stage. A total of 545 people testified at the three-day hearings—far more than those who spoke at all the hearings held in five other cities around the country.<sup>24</sup> Comments here were “the most scathing” of any of the previous hearings held in five states. Said Don Smith of Citizens for a Safe Planet: “We’re talking about the safety of the planet here...you’re not even concerned about the welfare of this planet! Where is your conscience? Do you have one?” Then after a pause, Smith told the DOE panel, “I hope you understand this isn’t directed at you personally.” Richard Johnson of Business Against WIPP, a Santa Fe group, drew applause when he declared: “If the WIPP trucks start rolling down St. Francis Drive, I assure you, there will be riots in the streets of Santa Fe.”

Expert witnesses also were not supportive of the DOE’s plans to bring in up to 25,000 barrels of plutonium-contaminated waste for a five-year experimental period before meeting EPA standards. Robert Neill, director of the EEG, the state’s watchdog agency, described such a demonstration as “not necessary to make a decision to use WIPP as an underground repository.” He added that putting in a large quantity of waste could result in unnecessary radiation exposure to workers because the waste would have to be removed from the underground area after testing.<sup>25</sup>

John Arthur, one of the DOE officials, said “I’m glad we’re doing this because we’ve gotten some really good public comments. I enjoy this. I know that sounds masochistic.” He professed not to be bothered when he was compared to Darth Vader or the DOE to the totalitarian Chinese People’s Republic. DOE officials acknowledged they would have a difficult time addressing the “anger, frustration and bitterness” against the agency expressed by an “overwhelming” majority of the witnesses at the Albuquerque and Santa Fe hearings. “There is a lot of emotionalism,” said Arthur. “As far as looking for an adequate resolution of that emotionalism...well, it’s mighty hard to do.” One thing the hearings did not do was alter DOE’s position that WIPP was a safe repository for nuclear waste, although Arthur said some of the testimony might change parts of the WIPP analysis in the FSEIS.<sup>26</sup>

Another broadside at WIPP at this time came from neighboring Texas. Attorney General Jim Mattox charged that leakage from the site could seep into ground water and end up in the Pecos River, which he described as “a precious resource in this



very arid part of the state.” He claimed that DOE was rushing too quickly to open the repository and should wait until the EPA developed new ground-water standards. Mattox threatened to sue if DOE moved ahead with the opening of WIPP. Lokesh Chaturvedi of the EEG said he did not consider contamination of the Pecos River from WIPP waste to be a serious threat, but added, “...one cannot completely rule out the possibility of there being fast-moving channels into the Pecos.”<sup>27</sup>

## Watkins Makes his Move

On June 27, Energy Secretary James Watkins announced that WIPP would not open in the fall of 1989. This announcement came as Watkins introduced a new 10-point plan to shore up environmental, health, and safety concerns at all DOE facilities in the face of technical setbacks and “torrents” of criticism. Senators Pete Domenici and Jeff Bingaman hailed the decision. In a joint statement, they said that until the problems were dealt with, “there [would] be no legislation introduced in Congress to transfer WIPP lands from the Department of Interior to DOE.” Representatives Bill Richardson, Joe Skeen, and Steve Schiff echoed the senators’ statements, adding that not facing up to WIPP’s problems would have “bogged down” the legislation—already bogged down since 1988—needed to open the plant.<sup>28</sup>



In 1989, Wendell Weart drove Secretary of Energy James Watkins around the tunnels and underground storage bins of WIPP. Left to right, Watkins, Weart, Governors Cecil Andrus of Idaho, Roy Romer of Colorado, Bill Miller of Nevada, and Jack Tillman, DOE WIPP manager.

The status of WIPP remained essentially static through the end of 1991. New Mexico's congressional delegation became more united (with the exception of Joe Skeen, because WIPP and Carlsbad are in his district) in its opposition to the opening of the repository without meeting EPA standards. Disagreements continued over the provisions of the WIPP Land Withdrawal Bill, especially over payments to New Mexico for construction of highway bypasses around cities on the routes over which the waste would be transported. Bruce King, elected governor again (1991–1994) expressed concerns about safety at WIPP, but did not object to radioactive-waste experiments at the site and preferred to leave the final decision up to Congress.

In June 1990, a ceiling section in a test chamber, long since closed to personnel access, collapsed, depositing a 165-foot-long, 100-ton slab of salt on the floor of a room that was being used for experimental purposes and was closed to workers. The DOE stated that the slab's fall had been anticipated and proved that the caverns mined out of salt beds were behaving as expected. However, Robert Neill of the EEG said the incident raised questions about worker safety at WIPP. "Any time something like a 100-ton slab in the mine falls, it should cause one to reflect," he commented. He added that the use of rock bolts to reinforce the ceilings could impair DOE's ability to gather useful data during the proposed five-year test phase.<sup>29</sup>

An increasingly impatient Watkins kept pushing Congress for the legislation that would allow WIPP to open, this time by January 1991. In September 1990, Watkins wrote to Senator Domenici urging passage of the bill and describing it as his agency's "highest priority." But Domenici and Bingaman replied in a "strongly worded" letter that they were "deeply dismayed" by the energy secretary's efforts, adding that WIPP legislation was still "premature and inadequate." In the House of Representatives, Bill Richardson continued to oppose any action on the bill.<sup>30</sup>

In October 1991, after the breakdown of closed-door sessions with Domenici and Bingaman, Watkins initiated an administrative withdrawal to have the land around the WIPP site transferred to DOE. The action, which did not include any long-term guarantees of health, safety, or economic aid for New Mexico from the federal government, resulted from overwhelming pressure to open the facility over the opposition of four members of Congress from New Mexico (excepting Skeen). Watkins, "appearing frustrated and agitated" after three weeks of negotiations with New Mexico's two senators, declared in a news conference, "WIPP is a \$1 billion installation. It costs the taxpayers \$13 million a month. I have a responsibility not only to the taxpayers but other states. We have reached the limit of our ability to negotiate."<sup>31</sup> The failure to pass the WIPP bill in Congress would cost New Mexico over \$60 million in federal money—\$20 million in economic aid and \$42 million in road improvement funds. Watkins said he would deliver the aid with the first shipment of nuclear waste, "but if the state sues the Energy Department, it won't even get that."<sup>32</sup>

Watkins was referring to New Mexico Attorney General Tom Udall's vow to sue the DOE to prevent the opening of WIPP, a threat that was "only mildly endorsed" by Governor King who suggested out-of-court compromises could still be reached. King urged New Mexico's congressmen to renew negotiations with DOE over how to conduct the test phase of the WIPP repository. Another supporter of Watkins's decision was Governor Cecil Andrus of Idaho who viewed it as a "positive step on a long road."<sup>33</sup> Udall declared he would seek a temporary restraining order against the DOE in federal court saying, "We believe this is an illegal action by Secretary Watkins....We're going to proceed to court to stop the administrative withdrawal and the movement of test waste to the WIPP site."<sup>34</sup>

The tensions over WIPP between the state of New Mexico, its congressional delegation, and the DOE now attained a remarkable level of public irascibility. Undeniably the New Mexico politicians were feeling some pressure from the vocal, well-organized national and local environmental and anti-nuclear groups, located principally in Albuquerque and Santa Fe. But issues of states' rights were also involved as was jockeying by New Mexico authorities for federal funds. And the DOE was bearing the legacy of distrust for the secrecy and some policies of its predecessor agencies, the AEC and ERDA, in years past. The earlier internal disagreements at DOE over whether to use the WIPP repository solely for transuranic waste or also to characterize the site for high-level military and commercial waste sounded duplicitous to many state



Energy Secretary Watkins (center) and Governor Bruce King (right) visiting WIPP in 1989.

officials, citizens, and journalists. And by the 1980s and 1990s, the United States had become a highly litigious society; many activist groups used the courts as the first line of defense against what they perceived as encroaching big government. And the efforts of the federal government to seek locations around the country to build repositories for nuclear waste seemed to many state officials and citizens as an intolerable encroachment on their individual and political rights. The “not in my backyard” attitude was prevalent, as well as a feeling of regional exploitation. WIPP was an exception, because its



Senator Pete Domenici examines instrumentation for a WIPP underground experiment.

“backyard”—the Carlsbad community—supported the repository. Most of the facilities producing radioactive wastes were located in the densely populated states of the Atlantic and Pacific coasts and the Midwest, while the search for repositories was centered in thinly populated, desert states like New Mexico and Nevada. Although there were often sound geological and scientific reasons for this, many people in those states still felt as if the government and other states were taking advantage of their weaker political clout to use them as “dumping grounds” for radioactive waste produced elsewhere.

On October 31, 1991, Representative Joe Skeen introduced a bill in the House that would give the Energy Department control of the WIPP site in exchange for \$600 million for the state of New Mexico. This bill was identical to a Senate measure awaiting floor action. Skeen said that his bill had a better chance of passing the House and getting President Bush’s signature than the competing Senate measure. Richardson said he would support Skeen’s bill as long as it could be amended on the House floor to which Skeen reacted: “He’s [Richardson] been wanting to stick his oar in the mud all along. He’s going to have to come up with something that represents a compromise from his position.”<sup>35</sup> By November, the House Interior Committee had passed a WIPP bill, supported by Bill Richardson, that put significant environmental restrictions on radioactive experiments at the repository.

A few days later the Senate unanimously passed a bill that gave DOE control of the WIPP site in exchange for long-term health and safety guarantees for New Mexico. The measure provided \$600 million in aid to New Mexico over a span of 30 years in exchange for hosting the repository. The bill also provided for a test period of five to seven years, using 4000 to 8000 drums of radioactive waste. The experiments were to be reviewed by several outside agencies, and the EPA would determine whether WIPP complied with environmental laws. At Idaho National Engineering Laboratory, two bins were loaded with radioactive material, mostly glass, headed for WIPP but a DOE official said “it could be months” before they would be ready to ship. Only one bin—one sixth of a truckload—was approved and ready for shipment. It had taken almost four months to certify this bin, a process that generated 3500 pages of paperwork.<sup>36</sup>

However, in November 1991, U.S. District Judge John Garrett Penn issued an injunction blocking any shipments of plutonium-contaminated waste to WIPP. Two basic reasons for the injunction were that (1) WIPP did not have interim status for Resource Conservation and Recovery Act (RCRA) waste, and (2) administrative land withdrawal, rather than congressional withdrawal, was not legally adequate. New Mexico Attorney General Tom Udall, a major plaintiff in this suit, was praised by WIPP opponents disappointed with Governor Bruce King’s lack of enthusiasm for the lawsuit.<sup>37</sup>

While the House was wrangling over the two WIPP bills, Energy Secretary Watkins threatened to recommend that President Bush veto one of them. He had already endorsed the Senate measure that had resulted from lengthy negotiations between himself and New Mexico's two senators.

## **The Controversial Underground Bin and Alcove Tests**

The DOE's plan to carry out underground tests at WIPP with radioactive material was encountering increasingly heated opposition. The first set of tests, called the bin tests, involved placing plutonium-contaminated items inside metal containers, or bins, to measure how much pressurized gas was released. A second series of tests, designated as alcove tests, would store waste drums inside rooms carved out of the underground salt formation. Sandia felt that the bin and alcove tests were necessary, and DOE officials had long argued that the tests were needed because they would help in understanding how much gas the buried wastes would generate. These data, in turn, would help them meet the EPA's long-term disposal standards for WIPP. However, the EEG issued a paper with a "sharp critique" of the tests, suggesting they could be done more easily elsewhere. EEG Director Robert Neill said his group was not opposed to the idea of underground tests but it believed those tests should supply scientists with "relevant and useful" data. But the paper's authors, Lokesh Chaturvedi and Matthew Silva, said that the tests, which involved placing radioactive waste inside metal bins as well as underground rooms, were likely to confirm "what is already known." They said "it is not necessary" to conduct experiments with radioactive waste at WIPP because DOE's own analysis showed that Los Alamos National Laboratory and several other locations were better equipped for some of the tests. The paper said that as early as 1979, Sandia scientists had recognized the need to study whether a buildup of gases generated by buried wastes could fracture rocks and form passages for radioactive materials. But the issue "remained dormant" and a detailed analysis on the effects of gas wasn't done until 1989.<sup>38</sup> On the study of gas generation, Wendell Weart said in 1989 that Sandia had addressed the issue in the late 1970s:

[Sandia] conducted surface-based field studies on the permeability of the salt formations. These tests indicated that the permeabilities were high enough that gases generated from the wastes would simply diffuse away. The first really convincing evidence that gas generation could be a problem came in 1987 when we were studying brine seepage. We supplied the data to the National Academy of Sciences [NAS] panel, and it was brought to public attention in a February 1988 NAS report.

We realized as we acquired more data that the permeabilities we were measuring were less than we had projected earlier. This meant that gas would not escape into the formation rapidly enough to avoid pressure buildup. To improve our confidence in the permeability data, we have expanded our measurements of permeabilities at the suggestion of NAS at underground sites, including the area where the actual storage rooms are situated.<sup>39</sup>



In the summer of 1992, while the WIPP vote was building up to a climax in Congress, the NAS described DOE's plan for carrying out five years of underground waste tests at WIPP as having "no discernible scientific basis" and the likelihood was "small" that the tests would give scientists confidence that the waste would be safe there for thousands of years.<sup>40</sup> Leo Duffy, director of DOE's Office of Environmental Restoration and Waste Management, immediately wrote to NAS president Frank Press to "clarify" the panel's statement on the WIPP tests. The next day Press wrote to the chairmen of the three House committees with jurisdiction over WIPP telling them that some newspaper accounts of the report "misinterpreted the panel's findings" and concluded, "I wish to assure you of the panel's continued support for an underground testing program at WIPP."<sup>41</sup>

Additional fuel was quickly added to the controversy over the underground tests when veteran WIPP opponent Don Hancock of the Southwest Research and Information Center made public a draft of a Sandia report stating that the tests were "not cost-effective" and that other tests might have to be "scaled back drastically" if they were done at all. The Sandia report was quoted as indicating the bin tests "may not be technically warranted" because of problems analyzing the wastes before shipment. Even if the wastes were analyzed accurately, the report recommended that as few as 24 bins, or four truckloads, might be all that would be needed—a figure considerably lower than the 140 to 200 bins that were originally planned.<sup>42</sup>

Wendell Weart quickly responded to the report, pointing out that many of its concerns already had been addressed. One change was the recommendation to bring only 24 bins, although he couldn't specify the amount DOE planned to bring—most probably fewer than 140 bins. Weart said the report's comments reflected that Sandia had concentrated solely on whether WIPP could comply with EPA's long-term standards, and that there were still reasons for tests other than meeting those standards. "We think we have devised a way by which they can greatly reduce the number of tests with waste," said Weart. "We still see a need for bin tests...and while we see the alcoves as having a use, it's probably not for EPA long-term compliance." One reason for bringing waste, he continued, was to ensure that WIPP adhered to the Resource Conservation and Recovery Act (RCRA), passed by Congress in 1985.<sup>43</sup> This was the EPA regulation governing how hazardous waste materials must be treated, handled, and disposed. Explained Weart:

And our waste has that. We have heavy metals like lead or cadmium, we have volatile organics like carbon tetrachloride. As a consequence, there's a whole new set of regulations and a whole new set of regulators that we now have to contend with and, in fact, it's the RCRA...that gets the state involved in a regulatory oversight role because EPA has delegated...authority to the state for regulating hazardous materials. They [the state] have no role in regulating radioactive waste but they do have the role in regulating the hazardous component of that waste, so we have to deal with two regulations. Some of the specific requirements in the act are not really consistent with



one another—there's some internal inconsistency about the kind of postclosure monitoring you do, that sort of thing. The boundaries at which you monitor success or failure are not the same for the two, so it just makes for a kind of messy situation from the regulatory sense.<sup>44</sup>

Referring to the NAS report and the newspaper account of Sandia's draft report on the WIPP tests, Sandia president Al Narath explained to DOE's Leo Duffy: "We will discuss the NAS comment concerning 'Laboratory Experiments on Gas Generation' with NAS WIPP Panel members. We feel that laboratory experiments with duration of two years or less are usable and defensible to identify and characterize appropriate chemical reactions to include in a mechanistic gas generation model....I was pleased to note that the Academy continues to view progress in PA [Performance Assessment] as indicating that WIPP can successfully and safely perform its TRU disposal mission. I assure you that this Project continues to receive Sandia's strong support and my personal attention."<sup>45</sup> Dori Miller, director of Sandia's Nuclear Management Center, sent identical letters to all the members of the New Mexico congressional delegation to explain the "recent maelstrom in the Albuquerque newspapers" over the "DRAFT of the Executive Summary of the FY92 Review of the WIPP Gas Generation Program." She indicated that gas generation issues might be of more concern to meeting RCRA hazardous waste regulations both during pre- and post-closure of the repository than they would be to long-term performance relative to radionuclide transport. "The number of bins of real waste required for testing to assure that we understand these concerns," wrote Miller, "may be something less than the current program baseline of approximately 140. However, it is expected to be larger than the draft report's recommendation of 24 bins. All of this is subject to DOE review."<sup>46</sup>

## **Congress Passes the WIPP Bill**

Years of delays, haggling, recriminations, and debate reached their denouement on July 21, 1992, when the House of Representatives voted 382-10 for the bill that would open the WIPP. The House bill, along with a similar measure passed by the Senate in 1991, permanently transferred the 10,000-acre WIPP site from the Department of Interior to the DOE. In contrast to the Senate bill, the House measure gave the EPA much more power in overseeing WIPP's compliance with environmental law. And unlike the Senate bill, which contained \$600 million in federal money for New Mexico, the House bill contained \$40 million.

Representative Bill Richardson had attempted to amend the legislation by incorporating his traditional position of requiring WIPP to meet EPA standards before any tests could begin. Fellow House Democrats and the DOE accused Richardson of trying to hold up WIPP's opening. He riposted with an impassioned plea: "Are you going to stick us with an unsafe facility? We are becoming the garbage dump of the United States." And with a final rhetorical

lunge, Richardson called the initial agreement in the 1970s by New Mexico to accept WIPP as a “dumb decision.” He continued, “But I say to you, there’s a responsibility that other people have to the people of New Mexico.” Richardson then joined nine other representatives in voting against the bill.<sup>47</sup>

A House-Senate conference committee took more than two months to work out the differences between the measures passed individually by the two houses of Congress on the WIPP Land Withdrawal Act. On October 6 it was announced that a compromise had been reached, but Senators Domenici and Bingaman warned that Senator Richard Bryan, a Democrat from Nevada, intended to “filibuster WIPP to death” to make a point regarding the proposed high-level waste site at Yucca Mountain. On October 8 Senate Majority Leader George Mitchell intervened at Bingaman’s request and resolved the crisis by dissuading Bryan from proceeding with his filibuster. The WIPP bill passed the Senate that evening and President Bush signed it into law on October 20, 1992. One of the bill’s most significant provisions was that it formally designated the EPA as the regulator. Prior to that, WIPP was self-certified by DOE which meant that DOE interpreted regulatory requirements for the project.

In contrast to the disappointment felt by anti-WIPP activists, mostly in northern New Mexico, the city of Carlsbad was, as was to be expected, jubilant over the passage of the WIPP legislation. On November 1, 1992, the *Carlsbad Current-Argus* published a celebratory section as a “tribute to WIPP and its history, the people who made it possible.” The lead article pondered “Why Carlsbad?” and speculated: “Perhaps it was Carlsbad’s sense of duty to civilization, perhaps a desire to improve business diversity. Probably, it was a little of both because neither had been quite enough, previously or since, to prompt any community to volunteer to host a nuclear waste disposal project.”<sup>48</sup> The section contained congratulatory messages from Governor King, Senators Domenici and Bingaman, and Representatives Skeen and Schiff. Skeen thanked “first and foremost, the people of Carlsbad who fought this long fight. Your persistence and constant encouragement have sustained me, when the rigors of the legislative process were discouraging. I appreciate your willingness to accept this facility when so many communities in New Mexico—and in most other states—would have rebelled.”<sup>49</sup> Richardson, however, was not quite so congratulatory. Responding to a letter from Mayor Bob Forrest, he wrote: “We’ve had a stormy relationship, but in the end all the turmoil has probably been well worth it. I want everyone to know that if I had to do it all over again, I would do exactly what I did on WIPP....I intend to keep a skeptical eye on WIPP in the days ahead. You have not heard the last from me. In the meantime, however, let us try to work together in the future to avoid those deep divisions of the past. I am ready, and I hope you are too.”<sup>50</sup>

In November 1992, President Bush was defeated in his reelection bid by Bill Clinton, the governor of Arkansas. Just prior to the election, the *Carlsbad*

*Current-Argus* asked both candidates their position on the opening of WIPP. Bush replied, “This administration believes public safety and long-term environmental protection will be enhanced through the permanent disposal of these wastes in a mined geologic repository.” Clinton’s response was, “There are serious questions about the long-term suitability of the Waste Isolation Pilot Plant with respect to environmental and public health and safety concerns,” but his staff members commented that Clinton, as a candidate, “lacked access to the kind of information required to make an educated decision.” This exchange occurred before Bush signed the WIPP bill.<sup>51</sup>

## **A New Secretary of Energy Meets With Carlsbad Officials**

On December 21, 1992, President Clinton appointed Hazel Rollins O’Leary as the new Secretary of Energy, and she was sworn in on February 5, 1993. At the time, she was a senior vice president of Northern States Power Company in



Hazel O’Leary was Secretary of Energy from 1992 to 1997. She is shown here on a visit to WIPP.

Minneapolis, Minnesota, with prior government experience as deputy administrator for the Economic Regulatory Administration. She was also the widow of John O'Leary who had been deputy DOE secretary in the Carter administration. From 1981 to 1989, she was vice-president and general counsel for O'Leary Associates, an energy consulting firm founded by her late husband. Although some environmental and activist groups expressed disappointment at O'Leary's lack of experience regarding weapons complex and cleanup issues, others in the nuclear industry saw her as having "first-hand knowledge" on nuclear operations and problems in the high-level waste program.<sup>52</sup>

Energy Secretary O'Leary's first action regarding WIPP was to order about 40 DOE employees at the Albuquerque offices to move to Carlsbad thus establishing the Carlsbad Area Office (CAO). This resulted from a meeting she had with Carlsbad Mayor Bob Forrest and other city officials in which they requested that all key DOE WIPP positions be moved to Carlsbad. "She promised that the ones that do come are going to be decision-makers," said Forrest after the meeting. Carlsbad officials then turned their attention to Sandia, saying they wanted to pursue the relocation of Sandia WIPP scientists. "We're still very concerned about the absence of Sandia National Laboratories from the project," said John Heaton, a Carlsbad pharmacist and member of the Department of Development who had participated in the meeting with O'Leary, adding, "They seem to be out of touch with their scientific plan proposal." He went on to say that Sandia appeared to have a "very low order of concern about deadlines and timelines and production of relevant work. Perhaps a closer association with...the location of the project would be beneficial in terms of their ability to come forth with a test plan that is credible. Scientists are so physically removed from the project. They ought to be stakeholders in the project itself. And they're obviously not."<sup>53</sup>

The Carlsbad officials' public comments elicited a sharp reply from Sandia's Dori Miller in which she expressed her "disappointment," going on to say, "I would have expected that I or Sandia's public relations staff be contacted to allow a more balanced story." Miller pointed out Sandia's long involvement with the WIPP project and the close association that many of its employees had and continued to have with the Carlsbad community. She indicated that the scope of the WIPP project was "much larger" than just the activities in Carlsbad. "Keep in mind," she admonished, "that the design of the Test Phase Plan must take into consideration the direction of the Department of Energy, the needs of the waste generator sites in Washington, Colorado, Idaho, etc., and the recommendations of 13 separate oversight groups, including the National Academy of Science [*sic*], and the Environmental Protection Agency." Miller singled out Wendell Weart, "a virtual member of your community for the past eighteen years," who with his staff was working with DOE and Westinghouse to plan test activities that would produce the data necessary for a compliance decision.<sup>54</sup>

This public spat between DOE and Sandia on one side, and the Carlsbad business and political leaders on the other reflected the frustration felt by all parties with the continuing delays in opening the completed WIPP facility, now in its seventeenth year. It also was illustrative of the aggressive lobbying style of the Carlsbad people in their long effort to bring the radioactive waste repository to southeastern New Mexico. At this time it was reported that businesses owned in part by current Mayor Bob Forrest and former Mayor Walter Gerrels had done \$160,000 in trade with DOE since 1988. These were mainly the Motel Stevens, owned by Forrest, and the favored lodgings of both DOE and Sandia staffers who spent some \$66,000 there between 1988 and 1991. (Sandia rented a permanent room at the Motel Stevens so its people would have a place for after-hours meetings and to gather in the evenings and store belongings on weekends.) Gerrels's clothing store sold \$62,000 worth of shoes and safety boots to WIPP during the same period. None of the business done in Carlsbad with DOE and Sandia was illegal, because bidding rules were followed in all transactions.<sup>55</sup>

Top Sandia managers held a meeting on June 21, 1993, with Carlsbad officials to discuss the latter's complaints and the status of WIPP. Representing Sandia were President Al Narath, Vice President Dan Hartley, and Wendell Weart. On the Carlsbad side were Mayor Bob Forrest and five other officials.\* Narath remarked that both Sandia and Carlsbad had the same ultimate goal—disposal of waste at WIPP and that all parties must work together toward that goal while “respecting” the views of others. Narath said that “WIPP faces enough external critics that public dissension between supporters of WIPP cannot be in the best interests of the project.” Several of the Carlsbad participants repeatedly said that Sandia, because of WIPP now being an “experimental program,” was now “calling the shots” on WIPP and was “entirely responsible” for design and selling of the test program. They were clearly concerned that Sandia might “not wholeheartedly support” radioactive waste experiments at WIPP. Narath assured them this was not so, but care had to be taken to distinguish between the scientific requirements of the tests and the programmatic and policy objectives of DOE that were the real justification for conducting these tests. Weart emphasized the “valuable role” of WIPP-based radioactive tests in developing public and community confidence and support in WIPP's ability to safely accept and handle radioactive waste.<sup>56</sup>

One of the results of this meeting and the persistent self-promotion of Carlsbad by the city fathers was the establishment of a permanent Sandia office in that city. A “Quality Study Team,” of which Sandians Wendell Weart and Gwen

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\* State Senator Don Kidd; State Representative Bob Light; Cliff Stroud, president, Department of Development (Carlsbad); John Heaton, Department of Development; Lewis Whitlock, former state senator.

Pullen were members, recommended the “need for a key SNL decision maker and appropriate support staff in Carlsbad to support the Carlsbad Area Office’s programmatic activities.” George E. Dials, manager of DOE’s Carlsbad Area Office, directed Sandia to “select and assign a project manager, along with support staff, for the WIPP and National TRU Program activities to your Carlsbad office.” He indicated that the Sandia Carlsbad office should be established by February 28, 1995, adding that the “resident SNL manager should be fully empowered” to represent Sandia’s interests.<sup>57</sup>

Since the beginning of the WIPP project in 1975, Sandia had always maintained a presence in Carlsbad. Wendell Weart recalled the progression of offices:

We had an office in Carlsbad manned by Fenix and Scisson who was there around the clock and managed the drilling programs for us. We often had many drill rigs going at one time because, as usual, in these projects, you’re always in a hurry to get this information and reach the next milestone so we can start to put waste away. [As to] the offices that Sandia had over the years, we first occupied an old municipal water works building out on Stevens. Then when we outgrew that, we moved into a building on 401 Canal, which was a former Safeway supermarket. [We] occupied that for many years and then when our activities in site characterization began to slack off, we shared that building with Westinghouse who was the technical support contractor for DOE. Eventually we moved out altogether into an office on Main Street, operated out of that for many years and then moved into the offices we have now...still on Main Street but a little further north. So we’ve had a succession of offices in Carlsbad and I must say the ones we’re in now are the nicest quarters.<sup>58</sup>

These Sandia offices over the years provided working quarters for the WIPP personnel who commuted regularly to Carlsbad. Of course now, in response to Carlsbad’s wishes and DOE’s direction, Sandia established a new Center headed by a director, a management level just under vice-president. The new Center would be staffed by all persons who “performed their normal daily assignments” in Carlsbad, and, as Sandia Vice President Dan Hartley put it, “I believe it is essential to move the entire Carlsbad operation into a single Center.” Paul Brewer was named the Director and Site Manager for Sandia’s Carlsbad operations.<sup>59</sup> Wendell Weart declined to relocate to Carlsbad and was named Senior Scientist in 1995, thus terminating a 20-year tour of duty as Sandia’s WIPP Project Manager.

## **The Bin and Alcove Tests**

While Sandia management was relocating part of its WIPP staff to downtown Carlsbad, thus emphasizing to community leaders its commitment to the successful opening of the long-delayed repository, the controversy over the underground bin and alcove tests continued, both in public forums and within the DOE and its contractors.

Martin Molecke was the Sandian most involved in the bin and alcove test program. As discussed in Chapter 2, he had been in charge of the Materials Interfacing Interaction Test (MIIT) in early 1986 which attracted much international interest. He had a long history of designing and managing waste package performance tests for WIPP. Molecke, a native of Cleveland, Ohio, had a Ph.D. in nuclear chemistry from Carnegie Mellon University. He joined Sandia in 1976 and went right to work on the WIPP project. Molecke was principal investigator on all nonradioactive waste package performance tests, which included contact-handled and remote-handled TRU waste and defense high level waste. In 1988, he was assigned the task of developing and technically justifying the bin and alcove tests, which were extensions of TRU waste laboratory and planned in situ tests at WIPP, which Molecke designed in 1977.<sup>60</sup>

Another Sandian involved with the bin and alcove tests was Al Lappin, who joined the Labs in 1976 after receiving a Ph.D. in geology from Princeton.<sup>61</sup> At first he worked on what would develop into the Yucca Mountain Project, another long-delayed repository project evaluating the feasibility of the disposal of commercial spent fuel. Then in 1983, Lappin transferred to the WIPP project to lead the site-characterization group. This was toward the end of the Site Preliminary Design Validation (SPDV) phase. He was responsible for a series of site-characterization activities called for in the Consultation and Cooperation Agreement between DOE and New Mexico. These studies had to do with hydraulic testing, tracing testing, and other tests—altogether about twelve specific studies that were completed in 1988 and signaled the end of WIPP's main site-characterization phase.

Once the site characterization studies were completed in August 1989, Lappin became the supervisor responsible for Sandia's continued role in the bin tests. The original idea for the bin tests came from Jim Bickel in the Albuquerque DOE office and Richard Lynch, a Sandia chemist and director. According to Lynch:

The notion was that HQ...was looking for an early experiment with real waste in the WIPP. Jim and I believed that the only logical reason to do that would be to have an "admiral's" test with real waste, exposed to real brine, in the real environment where bacteria might, or might not, decompose the waste. However, such experiments should be contained and retrievable. Thus, the idea of self-contained bins which would communicate with the room environment through [high efficiency particulate air] filtered vents.<sup>62</sup>

The WIPP Bin-Scale Contact-Handled TRU Waste Test was intended to be "a multi-phase experimental plan to provide relevant composition and kinetic rate data on gas generation and consumption resulting from TRU waste degradation under WIPP repository relevant conditions."<sup>63</sup> The defined test program could involve about 600 drum-volumes of actual CH TRU wastes contained within about 124 separate test bins. A test bin was a metal container specifically designed to hold the wastes safely and allow for the periodic



sampling of released gases and waste-leached liquids. It was not intended to be a transportation or waste-disposal container. The test program was also expandable so as to add more bins, as required, to be tested in subsequent years. This expansion capability was needed to accommodate additional waste types; future processed waste types; tests to incorporate and help resolve further characterizations for EPA, Resource Conservation and Recovery Act (RCRA), or other regulatory and programmatic concerns; and additional tests to reduce any unacceptably large, experimental uncertainties indicated by initial results.<sup>64</sup>

The bin-test effort to commence tests at WIPP lasted from 1988 to 1992, although actual tests were never implemented. “What we ended finding out was a whole series of relatively unpleasant things,” according to Lappin.<sup>65</sup> One of these was that the complexity of the waste forms and the difficulty in characterizing them made it difficult to obtain approval to ship across state lines. However, the first shipment of test waste was within hours of shipment when Judge Penn issued an injunction prohibiting such shipments. The 1992 injunction issued by Judge Penn was still holding up operations at WIPP in early 1999. The end result was that the first tests were planned using only bins containing raschig rings, which are balls of silicate glass used in cleaning columns, so basically they are the simplest type of radioactive waste available. The two principal issues in the bin tests were radionuclide brine composition and gas generation, and “in terms of gas generation, we really didn’t expect much out of these raschig rings.” The gas generation justification for the tests “really kind of went away” because of a second factor in that “unpleasant” process:

There’s a world of difference between wanting to run an experimental facility, which is what we needed to do for the bin tests, and run an operating repository, which is what the Westinghouse MOC [Management and Operations Contractor] wanted to do in Carlsbad. The long and short of it is, they didn’t want anything to do with brine underground because from an operational perspective it gave them nothing but headaches. Adding brine to these bin tests, sampling brines underground, from their perspective there’s nothing good that can come out of that. If you have a brine spill underground, you’ve contaminated a potential nuclear repository. So, after a lot of thrashing around, the decision was made [to not] allow the addition of brine to any of these bin tests.<sup>66</sup>

Westinghouse’s decision was supported by the operational side of DOE, illustrating yet another example of conflicting interests within the federal agency, between the operational and experimental factions. The DOE operational people did not want to have anything to do with testing brines underground either because they wanted to open WIPP as a repository as soon as possible. Which was “odd,” according to Lappin, because the bin tests were a mechanism to declare WIPP open politically—a push that came mainly from DOE’s Leo Duffy. The argument was that the bin tests would make it possible to officially open WIPP and “everybody could declare a victory.” But the decision not to add or sample brine for the bin tests eliminated half the justification for these experiments. Smaller-scale experiments, including those involving brine, were eventually moved to Los

Alamos because no radioactive tests could be done at WIPP. So, because the complex waste forms could not be characterized accurately enough to meet all desired test requirements, it was impossible to calculate any significant gas generation rates without measurements of nuclide concentrations in the brines. When the state of New Mexico and others won their injunction against shipping wastes because of the RCRA issue and the notion of land withdrawal, the whole effort died. Because of the injunction in 1992, the schedule for the compliance demonstration was shortened by two years because the experimental bin and alcove test phase was eliminated. Originally, the compliance demonstration was scheduled for 1998, so it was moved up to 1996 after the bin tests were killed.<sup>67</sup>

The RCRA also had a major impact on the bin tests. In 1985-86, DOE's view was that RCRA would not be applied to the WIPP waste. When the bin tests were being put together, however, RCRA became a real issue because it focuses on solvents, also called volatile organic compounds (VOCs). Much of the TRU waste streams slated to be disposed of at WIPP involved use of solvents such as benzene and carbon tetrachloride and heavy metals like lead or cadmium. At the time that the bins were being readied for shipment, the EPA delegated enforcement of RCRA regulations to the state of New Mexico giving it authority to monitor and verify the waste shipments. This was different from radionuclide compliance, which was regulated out of EPA headquarters where the decisions were made for the compliance certification of October 1996. They reached an agreement that, for purposes of long-term disposal, the 10,000-year disposal, the hazardous waste regulations added no value and recommended that the land ban restrictions would not apply to WIPP. A congressional amendment to the Land Withdrawal Act eliminated the need for WIPP to address the 10,000-year isolation for nonradioactive hazardous constituents. Thus compliance with RCRA was not an issue for long-term disposal. The end result of using two different regulatory structures to govern two different aspects of WIPP was that even though mixed wastes were certified for storage in WIPP, they could not be shipped there until the state of New Mexico issued a permit allowing the nonradioactive toxic waste to be moved to the WIPP. And DOE failed to demonstrate to the state's satisfaction that the waste did not contain hazardous nonradionuclides.<sup>68</sup>

Al Lappin described just one of the pitfalls in the characterization process. The basic characterization technique used in the production plant to define the waste contents is called "process knowledge," where individual process lines are reliably defined as to what the bounds are on the waste content. "Frankly, there were some unpleasant surprises in the process of loading for the bin test....What we found out in opening one of the drums of waste was that basically every glove box was lined with aluminum foil. It was common practice, although it wasn't part of the process, for people at the end of the day to wad up and throw away the aluminum foil in the glove box." Lappin continued:

So we opened, I believe, 36 drums of waste to load up bins in Idaho, and one of the very first drums that we opened up had the process code called the TRUCON Code, which was for transportation. The drum contained a lot of aluminum foil which wasn't included in the process information at all, and aluminum at that time was light enough that it didn't show up in the RTR [real-time radiography], the radiography results we were using for waste characterization. So even though we only opened up 36 drums on that order, we got at least that one surprise I really remember. It almost certainly wouldn't matter in terms of long-term confinement, but in terms of being able to stand up and argue for transportation that you know what's in there, we found some results that didn't look good. So that's one of the things that pushed us [to use] raschig rings. We came very close to actually shipping bins—we had either four or six bins loaded and ready to go at INEL [Idaho National Engineering Laboratory]. I believe something like between 50 and 100 bins were actually constructed and each one was going to hold nominally between four and six drums of waste.<sup>69</sup>

The bins were from two to three feet tall and about three feet on the sides. They were rectangular and loaded from the top. The bins were specially designed to fit in the TRUPACTS, two bins to a container. The nominal experimental duration for the tests was about five years. But issues were raised, partly through the Environmental Evaluation Group (EEG), the state's watchdog group—issues of room stability during the projected five-year life span of the tests. During the bin test preparation, roof falls did occur in underground design validation rooms at WIPP as mentioned previously. Because of the issue of room stability, the actual room where the bin tests were to be set up was supported by a set of structured support systems. Load sensing rock bolts were installed in the roof along with I-beams, wire cables, and layers of wire mesh to prevent the roof from collapsing on the bin tests.

The bin tests made good sense from an experimental standpoint, but not from an operational and public relations one. Lappin reflected on the original proposal by Jim Bickel and Richard Lynch: "I think those fellows made that recommendation basically from the experimental perspective...they didn't have much understanding at that time of the operational constraints."<sup>70</sup> But once the idea was proposed and it became obvious that full-scale operations were going to take a long time, the pressure to do the bin tests at WIPP really built up at DOE Headquarters.

Regarding the role of Robert Neill's EEG, Lappin opined: "They were basically competent technically, but their most important role was to provide an avenue for responsible critics of the project to be heard other than just standing out on the street corner and going to the newspaper and raising hell about things....I think through the bin tests...they raised issues primarily about the utility of the tests."<sup>71</sup> When an operations demonstration was proposed in which real radioactive waste would be placed in waste panels, EEG consistently raised questions about the value that type of demonstration would yield. They also questioned the political and technical merit of the alcove tests. These were separately mined and sealed rooms in which waste would be placed and sampled for gas generation.<sup>72</sup>

Another nail in the coffin of the bin and alcove tests was an independent technical review carried out in 1993 by DOE's Office of Environmental Restoration and Waste Management. They evaluated the two types of underground tests proposed with TRU waste: the bin tests, using instrumented containers (bins) located in a large, easily accessible room; and alcove tests, using 1050 55-gallon drums placed in a sealed room. The review team concluded that "...there is no scientific, regulatory, or operational imperative to perform the Bin or Alcove tests at WIPP with radioactive waste." In October 1993, the National Academy of Sciences recommended with DOE's agreement to eliminate the bin and alcove tests with actual waste at the WIPP and to perform additional experiments in laboratories.<sup>73</sup>

Martin Molecke, who left the WIPP project in 1993, offered a postmortem on the bin tests: "We honestly tried, put a hell of a lot of work into it. It was a tremendous technical challenge and political nightmare."<sup>74</sup>

## **Performance Assessment and The System Prioritization Method**

In August of 1986 Sandia had accepted a formal request by DOE to take responsibility for showing the WIPP repository's compliance with the Code of Federal Regulations Part 191 (40 CFR 191), the EPA regulation governing nuclear waste regulation.<sup>75</sup> In preparation for the eventual Compliance Certification Application (CCA), Sandia conducted four preliminary performance assessments (PAs) which are defined, according to the EPA definition, as an analysis that (1) identifies the processes and events that might affect the disposal system over 10,000 years, (2) examines the effects of these processes and events on the performance of the disposal system, and (3) estimates the cumulative releases over 10,000 years of radionuclides considering the associated uncertainties caused by all significant processes and events.<sup>76</sup>

These four preliminary PAs were conducted between 1989 and 1992, each one building upon the other. They employed mathematical models, and the general long-term flow path for radioisotope release was similar to the one used in the initial Environmental Impact Statement in 1980. But the simulations were stochastic (probabilistic, parameter values were randomly selected to account for uncertainties) and many complexities were added, such as human intrusion causing radioisotopic releases from drill cuttings. Vast amounts of records and documentation were produced to ensure that the reasoning behind choices for data and models was traceable and repeatable.<sup>77</sup>

A little prior history will help set the context for Sandia's assumption of PA responsibilities for WIPP. DOE/ALO had originally assigned Westinghouse with the PA task in 1984 but requested that Sandia take it over to facilitate the

required interactions between the experimental (data developers) and PA (data users) staffs. Noting that “appreciable sensitivity exists with this topic and the proposed transfer of responsibility from the WIPP Operating Contractor,” ALO emphasized that such a transfer should ensure a “smooth transition of responsibility.”<sup>78</sup> When Wendell Weart was first approached by Randy Cooper, WIPP DOE Project Manager, about this new responsibility, it was a complete surprise to Weart. Because it came at an opportune time and matched Sandia capabilities, Sandia Vice-President Everett Beckner replied on August 29, 1986, that “Sandia will be pleased to take on the challenging task of performance assessment to address compliance of WIPP with the EPA standard 40CFR191.”<sup>79</sup>

In 1988, the Subseabed Disposal Project (SDP) was terminated by Congress by the Nuclear Waste Management Policy Act, which designated Yucca Mountain in the Nevada Test Site as the sole site to be developed as a civilian commercial waste repository, eliminating all other sites (and methods) from consideration. A number of Sandians who had been assigned to the SDP project were reassigned to WIPP, including D. Richard “Rip” Anderson who organized the WIPP PA effort. The core group consisted of Melvin Marietta, who brought his organizational skills and experience in large-scale modeling and put the team together. Rob Rechard had not worked on SDP but instead directly supported NRC on developing a generic PA methodology for high-level waste. Sharla G. Bertram, a specialist on environmental legislation, came directly from SDP and Regina Hunter, who did scenario development, moved over from the Yucca Mountain Project.

The WIPP PA team’s first task, starting in January 1988, was to develop a modeling system. The National Academy of Sciences (NAS) took great interest in the team’s activities. Still, it took the team a year to get organized—many skills were available to it but the group needed to get organized. In the meantime, “Rip” Anderson submitted quarterly reports to the NAS panel. However, in early 1989, NAS wanted tangible indications of progress in the development of the PA modeling system. The team built a quick demonstration system which became the 1989 PA. In 1990, a full-scale modeling system was in operation. Simultaneously the team had to identify scenarios to be modeled. They referred back to the ones that Felton Bingham and George Barr had developed for the Final Environmental Impact Statement (FEIS) in 1980, and a study performed by Regina Hunter.<sup>80</sup> NAS wanted detailed analyses of phenomena but wanted them simplified when put into the PA modeling system. Sandia opted to go with the detailed modeling.<sup>81</sup>

An important step in PA is to identify potential hazards that might disrupt the geologic disposal system. The first list of hazards for consideration at the WIPP was published in 1974 at about the same time as site selection. The list was

updated in 1979 by Bingham and Barr, as mentioned above, for the 1980 FEIS, in 1989 for the preliminary PAs, and in 1995-96 for the final PA. Although the process of identifying hazards and then selecting specific hazards for modeling was relatively informal initially, with each iteration the process of identifying hazards became more rigorous.<sup>82</sup>

Several hazards were identified in the 1980s which might compromise the disposal system and mandated investigations by agreements with the state of New Mexico. The possibilities of deep dissolution of the Salado (to form breccia pipes) and dissolution at shallower depths in the Culebra at the site (causing karst hydrologic flow) were examined by the United States Geological Survey (USGS) and Sandia. These issues were resolved as either not likely to occur at all or not in a manner that would impair WIPP performance, respectively. However, by 1987, the presence of a brine reservoir under the repository in the Castile could not be unequivocally dismissed and so became a potential undetected feature. In addition, the Supplemental EIS of 1989 identified gas generation as an important process to examine.<sup>83</sup>

PA was a driving force for the WIPP project beginning from about 1987. It was a major effort at developing a procedure, model and code development, and other tasks to actually show compliance of a real disposal site with probabilistic EPA regulations. PA had previously been prepared for other potential repository sites, but the results of those studies were not intended for a critical review by the EPA.<sup>84</sup>

In 1994 and 1995 Sandia designed and implemented a planning process called the System Prioritization Methodology (SPM), initiated by Paul Davis. Key individuals in conducting and completing the project were Nancy Prindle, Deirdre Boak, Fred Mendenhall, and Richard Lincoln. The goal of SPM was to provide information about how potential activities—twenty-one scientific investigations, three engineering alternatives, and two waste acceptance criteria—when viewed singly or in combination, could contribute to a demonstration of compliance with EPA long-term performance requirements for the WIPP disposal system.<sup>85</sup> For each combination of activities SPM calculated the probability of demonstrating compliance along with the projected cost and duration of that combination of activities. These performance measures (demonstrating compliance, cost, duration) were analyzed to find programmatic options that maximized incremental compliance demonstration while minimizing cost and duration. Performance assessment models were used to estimate how the disposal system might perform if activities were implemented, and this evaluation was the basis for calculating the probability of demonstrating compliance. SPM analyzed roughly 46,700 combinations of activities. The compliance schedule was accelerated by several years and saved about a third of a billion dollars. DOE considered SPM as a very useful tool in helping to determine how to appropriate funds to achieve compliance effectively.<sup>86</sup>

## The Compliance Certification Application

The Land Withdrawal Act of 1992 provided that EPA would be WIPP's regulator and their anticipated regulation was prescriptive on how to conduct the performance assessment (PA). Sandia was well positioned to conduct these formal PAs for the compliance certification by virtue of its responsibilities in the PA area since 1986. In March 1995 the PA conducted by Sandia was included in a draft Compliance Certification Application (CCA) and this was followed in October 1996 by the final CCA containing Sandia's performance assessment for the WIPP. This effort, led by Rip Anderson and Mel Marietta, consumed the full attention of dozens of Sandians in the years leading up to this successful certification application to the EPA.<sup>87</sup>

The CCA consisted of 21 volumes containing over 20,000 pages of documentation plus an additional 50,000 pages of reference material representing the results of more than 20 years of scientific study of the WIPP site by Sandia scientists. This massive document formed the basis upon which DOE was asking the EPA to certify that the site was safe for permanent disposal of TRU wastes. Wendell Weart, since 1995 the WIPP Senior Scientist, stated at the time, "We can say with confidence that WIPP is a very robust repository. The geotechnical studies overwhelmingly suggest that no natural processes will breach the site during its 10,000-year design lifespan."<sup>88</sup> The Sandia science team looked at earthquakes, erosion, volcanic activity, hydrology, and tectonics and concluded that none of these processes appeared remotely likely to pose a threat to the site's stability. In fact, the only mechanism for potentially releasing radiation from the repository would be human intrusion in the form of well drilling or mining. "To minimize the chance of that happening during a multigenerational time-frame," said Weart, "Westinghouse [the site contract manager] has designed a system of markers to warn off curious humans."<sup>89</sup> Margaret Chu, a chemist and deputy project manager, said the CCA "represents a big step, a major milestone." She added, "The quality of science done during the WIPP studies was extraordinary....As a result, there is probably no single piece of similar-sized real estate on the planet that has been more closely studied and thoroughly characterized than the WIPP site."<sup>90</sup>

The completion of the CCA was "an intense and grueling series of DOE internal and DOE-conducted external reviews," according to Al Lappin's recollection. "We basically spent the last six months before the CCA [was submitted] in an exhaustive DOE-controlled peer review, records review, documentation review, QA [quality assurance] review, you name it."<sup>91</sup> The review focused on all data or conceptual models being used in the CCA. For example, in the area of hydrology, some of the test data extended back into the 1970s. The years of information that went into the CCA ranged from some data that were roughly 20 years old to field tests that were still in progress while the CCA was being written—one of these field tests was turned off in April 1996. "For better or





Margaret Chu peruses one of the 21 volumes of the Compliance Certification Application.

worse,” said Lappin, “[that meant we] had 20 years of development in QA issues, and the approach to quality assurance was totally different in the late 1970s than in 1995 and 1996. So it was an agonizing review process before the CCA went in.”<sup>92</sup>

Once the CCA was submitted to DOE, who, in turn, submitted it to EPA in October of 1996, an “equally agonizing” series of reviews began with EPA and its contractors. Thus from October 1996 to December 1997 Sandia’s WIPP staff was engaged in a continuous EPA review going back through all the records on a parameter-by-parameter basis. The EPA would start with the compliance model and want to look at a given parameter within that model, and then try to review all of the individual test data that went into defining the model parameter and try to track all the records. So the Sandians and EPA staff were put in the position of having to review, in a year and half, not only the model results for all of the compliance calculations, but also up to 20 years of information that went into developing the inputs of those

models. “I mean, it was a huge review task,” remembered Lappin. “They exhausted themselves, [and] everyone here at Sandia [who] was involved.”<sup>93</sup>

## Quality Assurance

To better appreciate Sandia’s experience in assembling the CCA, one has to understand the Quality Assurance (QA) requirements as they evolved from the late 1970s when Sandia first assumed responsibility for the scientific investigations at WIPP. Wendell Weart recalled that “we had our own QA requirements and DOE always looked at what we were doing but it was a much easier, less detailed process than we have now.” DOE’s audits were quite general

in those days and on occasion they would point out some adjustment in the way Sandia was carrying out the work. Still, Weart recalls QA people at DOE Headquarters when meeting with geoscientists “trying to be very strict” and seeking to impose reactor-type QA to Sandia’s site studies; the latter usually entailed a geologist walking through the field making observations, recording impressions, and making professional judgments. Hot arguments broke out because the geologists disagreed on how to apply construction and design QA rules developed for nuclear reactors to geologic field operations. “So it was fair to say that my observation in the early days, because I saw both sides of it,” Weart said, “was that QA was regarded by earth scientists as an unnecessary evil. We’ve evolved today to where I suppose some still think of it as an evil, but a necessary one. But in fact, I think most of our scientists now understand that doing the job right and adhering to QA requirements will in the long run make their job easier, when they are required to address external regulations.”<sup>94</sup>

Susan Pickering joined Sandia’s QA group in November 1988 as WIPP QA Chief, which was equivalent to a team leader because the position was not yet of management level. In 1993, still a Sandian, she went to work in the RCRA area and then moved over to the National TRU Program (1994 and 1995). In 1993, Al Stevens became manager of the WIPP QA program. Stevens was a long-time Sandia veteran whose most recent assignment had been with the Yucca Mountain Project, which had an extensive and elaborate QA program. When Stevens retired in 1995 and Pickering replaced him as QA manager, the requirements had changed dramatically. The event that transformed everything was the passage of the WIPP Land Withdrawal Act in 1992, legislation that formally designated the EPA as the regulator. Prior to that, WIPP was to be self-certified by DOE which meant that DOE interpreted QA requirements for the project. With the EPA as the new regulator, QA became “much more prescriptive, much more formal” requiring a great deal more documentation than previously. The implementation of 40 CFR 194 required adherence to three QA standards designated as NQA1, NQA2, and NQA3. NQA1 was written for power plants and emphasized construction and inspection. NQA2 “brought in a world” of software requirements that Pickering said “we were nowhere near meeting, and it had a huge impact because with R&D and the kind of work that we do, software requirements are very, very important.” And NQA3 covered data collection and sampling, a great deal of which had already been collected under other QA procedures.<sup>95</sup>

So Sandia now had a whole new set of standards to which future work had to conform. And the work done since 1975 also had to conform to those standards or it could not be used in the CCA. To illustrate the growth of the QA program, when Pickering joined the group in 1987 the budget was \$160,000 and the staff consisted of one Sandian and one contractor. By 1997, the budget had grown to \$2.2 million and the QA staff had grown to almost

20. Prior to 1992, DOE's main concern had been safety during the construction phase. When EPA assumed responsibility, the emphasis became long-term containment. When DOE was responsible for QA standards, they audited Westinghouse more stringently than they did Sandia. When EPA became the regulator, the situation was reversed, and Sandia's work became much more important as the area of interest.

Weart reflected on the effects of EPA's QA requirements:

Some of the things I always think of as being essential to QA in a scientific program, we thought we did pretty well. We tried to calibrate our instruments and relate them back to the National Bureau of Standards. But one of the problems was that we felt that if we did that, it was enough. We didn't have to keep all the records and the traceability. Some programs did it pretty well, others did it hardly at all, and that's what really made it difficult when we tried to go back and qualify the existing data as having been done under a good QA process. Because while we think we did the right things, it's hard to prove you did the right things. And as to qualifications of people in the early days, we just assumed that if you're employed by Sandia you had the qualifications and you never wrote it down anywhere.<sup>96</sup>

One of the exceptions to this relaxed attitude toward documentation on the part of the early WIPP project scientists was Darryl Munson who was in charge of several test rooms in which experiments were carried out to understand the thermal-mechanical properties of salt. He was also responsible for all rock mechanics experiments at WIPP. He maintained an extensive notebook collection, which still forms part of Sandia's QA records. Munson's scientific approach was so detailed and well documented that he was already meeting the intent of a good QA program. His data "sailed through" the EPA process because they were so well documented. Other Sandia scientists who thought that their final Sandia (SAND) reports would suffice to satisfy QA requirements had considerable difficulty getting through the screening and becoming qualified. As might be expected, individuals differed in their approach to their work and what level of documentation they thought was adequate and appropriate.

Al Lappin addressed the problem of trying to use published SAND reports as the end product of the QA records. "One of the odd wrinkles from the QA perspective" explained Lappin, "is that external publications in the peer-reviewed literature were accepted by QA without question, but things published within the project had to have all this documentation on underlying records." External publications are scientific journals and SAND reports didn't count as external publications because they generally did not have external (non-Sandia) peer reviewers. There was a "real concern" from a QA perspective when the record trail showed a discontinuity and a conclusion could not be supported by detailed documentation demonstrating the data on which it was based. "It was addressed as a QA issue," observed Lappin, "but I think it's a much deeper issue of credibility.

And that poses problems on a 20-year-old project because your understanding of any part of the system evolves and changes over that period of time. You get more information, your understanding of your conceptual model of things changes and evolves, and from a procedural point of view that's very hard to track."<sup>97</sup>

From the regulator's perspective as well as from a legal one, it is critical to track the decision-making process and explain why understandings arrived at a particular time are abandoned. The technical community always assumes that the latest publication is obviously the right or better answer, or it would not be worth publishing. And rarely does any effort go into explaining why the old conceptual or mechanistic model was abandoned. "I'm sure this will happen if any of the injunctions in effect now are challenged in court," Lappin explained. "You hold up two SAND reports that deal with the same topic and both have absolutely equal credibility from both a regulatory and documentation perspective, particularly if written by the same author. And they [the regulators] say, well, in this paper you say it's this process that controls the test, and in this other SAND report, it's a different process. Can't you make up your mind?" What has occurred, explained Lappin, is that one understanding has evolved into the second one, but unless the time and effort is taken in the second paper or report to describe the decision-making that led to adopting that understanding, the final conclusion is vulnerable to questioning.<sup>98</sup>

A significant management change in DOE which affected the approach to QA was when George Dials was appointed as manager of DOE's Carlsbad Area Office in 1993. "He was very forceful, very decisive, and really united the project," Pickering recalled. He was a strong advocate of QA and described it as the "weak underbelly" of the project. Les Shephard, who was Sandia's WIPP project manager from 1995 to 1998, was also crucial in moving the project into the compliance mode. Projects of the length of WIPP tend to develop some inertia, and it is hard to initiate any kind of significant change. Al Stevens encountered this and tirelessly inculcated in an often skeptical staff the importance of developing and accepting the importance of QA procedures.<sup>99</sup>

## **Passive Institutional Controls or The 10,000-Year Trip**

The EPA required the use of passive institutional controls (PICS) to inform future generations of the existence of the WIPP nuclear waste repository and to warn them against inadvertently intruding into the repository and its contiguous 16 sections. In essence, this was the main purpose of the CCA, to provide reasonable assurance that the site would safely contain its radioactive residue. The overriding concern on the part of both WIPP supporters and critics was that someone in the future would unknowingly drill into the repository, thus releasing radionuclides to the accessible environment.

The CCA considered two time periods: (1) The first was the 700 years after repository closure during which it was assumed government would continue to exist along with regulatory agencies. There would be some kind of continuity with predecessor agencies, thus maintaining record keeping on natural resources exploration and exploitation. Also it was assumed that current English would continue to be understood by people generally, in government, and in the natural resources industry. (2) The second time period was the regulatory 10,000 years. This was of concern to performance assessment and presented greater problems of political, cultural, and linguistic continuity. Consequently, the methods of communicating the location of the WIPP repository to the generations in the distant future posed a greater challenge.<sup>100</sup>

In 1990 Sandia assembled a Futures Panel to address this complex question: How do you prevent the as-yet-unopened repository from becoming a hazard in the coming millennia? The panel consisted of 16 professionals from various fields who considered ways to protect WIPP against future intruders. Sandia scientists D.R. “Rip” Anderson and Kate Trauth helped convene the panel. “[One group in] the panel will first try to predict what life will be like in the year 12,000 A.D.,” said Anderson. “In order to see how people are going to intrude, you have to see what humans [might] be like in 10,000 years. Another group would consider petroglyphs and other warning markers.” Among the panelists were Norman Rosenberg, director of the climate resources program for Resources for the Future, a Washington, D.C. consulting group. Another was Gregory Benford, a physics professor at the University of California-Irvine and author of several critically acclaimed science fiction novels.<sup>101</sup> His most recent book at the time was *Beyond the Fall of Night*, which was about the last living cities on Earth. It was co-written with Arthur C. Clarke, author of the classic *2001: A Space Odyssey*. One panelist, Yale University sociologist Wendell Bell, observed that most futurists look ahead only into the next generation, “not the next 300 or so.” WIPP’s leading critic, Don Hancock, expressed skepticism over whether the panel could really accomplish anything. Robert Neill of the EEG favored convening the panel but said its views “shouldn’t be taken as gospel.” “These are concerned and knowledgeable people,” he said, “but experts they’re not. There are no experts.”<sup>102</sup>

Nonetheless the panel proceeded with its work and produced a report titled *Expert Judgment on Inadvertent Human Intrusion into the Waste Isolation Pilot Plant*.<sup>103</sup> The panelists concluded the odds of a future warning being effective improve if the same warning is delivered several ways: Marking the burial site with a universal danger symbol and tombstone-like monoliths engraved with messages in several languages. Some proposed an “atomic priesthood”—a relay system to pass the word by mouth from age to age. “The atomic priesthood is merely a fancy term for a self-perpetuating committee or task force,” commented panelist Thomas Sebeok of Indiana University. “The worst way is to entrust the government. The idea is that each generation should re-input

the warning and relay it to the next, with the veiled threat that to ignore the mandate would be tantamount to inviting some sort of supernatural retribution.”<sup>104</sup> Perhaps something akin to the purported curse of Pharaoh Tutankhamen’s tomb.

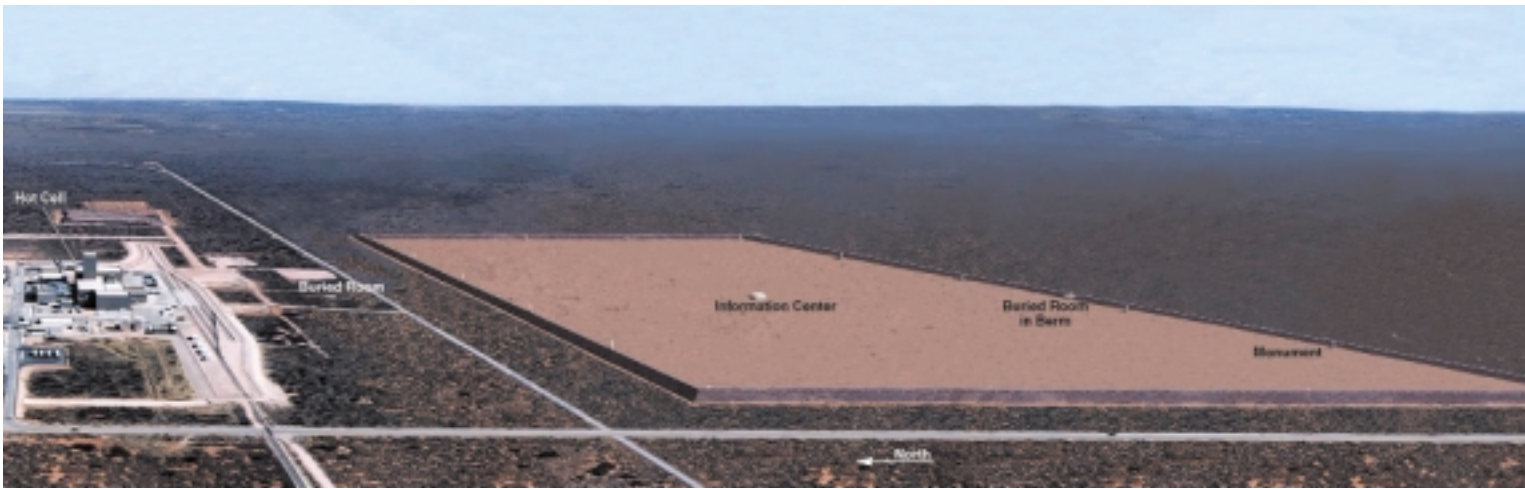
DOE’s 1996 report concluded that the PICs would include “markers, records, archives, and government ownership and land-use restrictions.”<sup>105</sup> The report went into great detail to make its conclusions and recommendations dovetail with EPA regulations. It established a somewhat complicated system of “credits” for performance assessment that “assesses the performance of the disposal system for isolation of wastes from the accessible environment [and for which] the EPA prohibits consideration of any contribution from AICs [active institutional controls] in preventing human intrusion for more than 100 years after disposal.” The period of a century for AICs was predicated on EPA’s belief that the “U.S. government—with its institutions, laws, and sanctions—[would not] collapse in 100 years or change to an extent that a location as important as the WIPP will be forgotten. Indeed, other countries have expressed more faith in their governments. Their waste disposal systems will rely on active controls for 100 to 500 years.”<sup>106</sup>

One of the more interesting sections of the report concerned various monuments and buildings from antiquity and how well they have resisted the ravages of time (weather, earthquakes, wars, etc.) and still transmitted their messages to modern civilization. The earliest recorded human history begins with Sumerian civilization between 6000 and 4500 B.C.E. By the latter date, the Egyptian state was being established although the earliest monuments of interest to the DOE panel were the pyramids, specifically the Khufu pyramid whose markings “have remained intact and communicated their message over a period of more than 4,500 years.” WIPP’s buried rooms would be available for “at least 4,500 years, with a high probability of lasting beyond the regulatory period [of 10,000 years].”<sup>\*</sup> The surface markers would consist of an “Information Center”—a central monument consisting of massive granite walls engraved in English and other major languages and pictures. Other, smaller, monuments would be erected on the perimeter of the WIPP footprint and the outer boundary of the 16-section withdrawal. Relatively small markers would be buried at randomly selected locations and depths.<sup>107</sup>

In Wendell Weart’s view, the report’s conclusions are always easy to attack because “there is no expert any better than I am on what’s going to happen over 10,000 years.” And he acknowledged that in a sense the critics are right, but all that could be done was to assemble really broad thinkers who had the

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<sup>\*</sup> Of course, salt creep would have long since closed up the rooms; it is the radioactive waste within that lasts between 4500 and 10,000 years.



An artist's conception of what the WIPP site will look like after the site markers (earthen berm, granite monuments, and information center) are emplaced. In order to show the site buildings, the berm, and the monuments in one drawing, the scale is off, and the monuments are shown larger than they will actually be. The repository buildings are shown for reference; after closure of the repository, the buildings will be removed. The area outlined by the earthen berm is the vertical projection of the location of the waste panels (also called the repository footprint). The idea behind the rectangular berm is to communicate that the area within the berm is somehow different. If someone drilled within the berm, the borehole would be in and among the waste panels and could intersect a waste drum. If someone drilled outside of the berm the borehole would not intersect the waste panels and a waste drum could not be intersected. The drawing does not include the granite monuments that will be placed on the boundary of the WIPP Land Withdrawal Area (a 16-square mile area that encompasses the repository footprint).

benefit of broad backgrounds and present the issue and problem to them. Then the panel was asked to come up with suggestions independently of project biases. Still, the critics faulted EPA for allowing DOE too much leeway in how much deterrence passive markers can provide. So EPA “changed markedly” from their initial standard when they limited DOE to take credit for deterrence for no more than several hundred years, often interpreted as 700. This is a short time compared to the 10,000 years during which WIPP has to be safe from human intrusion. “It’s really not all that effective for us in the overall picture,” said Weart, “and we can’t even assume that it will be 100 percent effective for 700 years.”<sup>108</sup>

Al Lappin, although he was not directly involved in the PIC study, reflected on its outcome: “It was quite an issue in the EPA review because basically the driving thing in the performance assessment is human intrusion into the mine, and the sum of the rates that you have to assume depends on the amount of credit that you can take for passive markers, letting someone know there’s something there they shouldn’t want to drill into. And so it was a real issue with the EPA because decisions about the passive markers really played a role in the compliance and in controlling the frequency of drilling intrusions that had to be assumed in the final compliance regulations.” In other words, the marker has to attract attention or else it will not be not be effective. Once it attracts attention, it must successfully tell people to stay away. Or its attractiveness could result in someone drilling at the site.<sup>109</sup>



## A Conclusion and a Beginning

“Like a bride waiting at the altar, WIPP has expected its TRU love since 1988,” wrote a visitor to the site in 1995.<sup>110</sup> Speaking informally to 200 WIPP workers in Carlsbad, Energy Secretary Hazel O’Leary declared in 1994, “People need to be certain that I, along with you, am committed to the opening date of the Waste Isolation Pilot Plant in 1998.”<sup>111</sup> In 1997 Federico Peña, former Denver mayor and most recently Secretary of Transportation, was appointed by President Clinton to succeed Hazel O’Leary as Energy Secretary. Two energy secretaries and 1998 itself passed, but WIPP still had not received its long-awaited TRU wastes.



Cross section of drums containing typical transuranic waste. Starting at the left, the first drum contains glassware; the second drum is filled with sludge from the processing line where separation of plutonium from other materials takes place; the third drum contains assorted hardware; and the fourth contains clothing and organic waste.

WIPP supporters saw some positive movement when George Dials, DOE’s Carlsbad Area Office manager, declared that no state permit was needed for waste drums loaded with only plutonium-contaminated material as long as they did not contain lead, cleaning solvents, or other hazardous materials. This position was a departure from DOE’s own environmental analysis that WIPP would not open until the state permit was issued, although Dials disagreed with that interpretation. He stated that WIPP could open in the spring of 1998 and immediately begin accepting drums of radioactive waste that did not contain additional chemical waste. Dials said he expected the state of New Mexico to eventually issue the permit for hazardous chemical waste in accordance with the provisions of the RCRA. New Mexico Attorney General Tom Udall, at this time WIPP’s most vehement critic in state government, complained that Dials had gone back on past assurances and that this “certainly [did not do] much for DOE’s credibility.”<sup>112</sup>

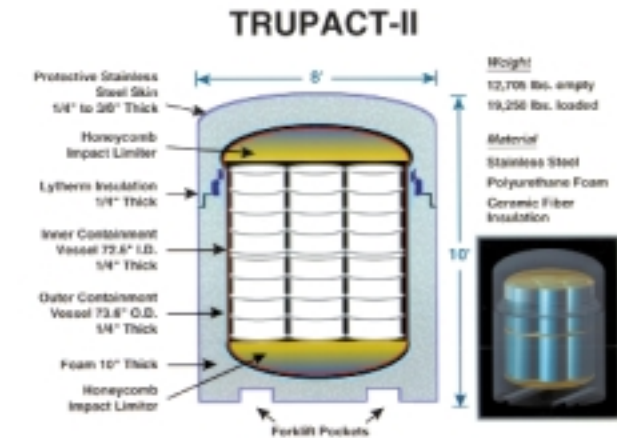
The state permit was one of two significant regulatory hurdles remaining for WIPP. First, public hearings were required and held after DOE’s submittal of the CCA in October 1996. Second, the EPA had to certify that WIPP could safely contain radioactivity for 10,000 years, after which DOE would issue a formal

decision to proceed with WIPP. In October, the EPA issued a preliminary certification, and final approval was expected in April 1998 with DOE officials aggressively pursuing a May target date for opening WIPP.

Dials said that roughly 40 percent of the total number of waste-containing drums did not contain chemical waste and could be shipped without a hazardous-waste permit from the state, a stance with which the EPA agreed. Udall, however, cited notes from one of his staff attorneys that indicated Dials said in two different meetings with state officials in 1994 that no waste would be sent to WIPP until the state issued a hazardous-waste permit. Dials countered that the meetings occurred before Congress exempted WIPP from one of RCRA's requirements and before EPA "gave a definite determination...that they would not oppose opening WIPP before the hazardous waste permit was issued." In summary, Dials said, "The attorney general does not want this [WIPP] open. That doesn't change the fact that the attorney general is not the regulator." Continuing the mutual disagreements over the wording of the regulations, Udall indicated a page in DOE's Final Environmental Impact Statement that said the agency "must obtain a RCRA Part B permit from the State of New Mexico Environment Department before it can operate WIPP as a transuranic waste disposal facility." Dials dismissed Udall's point by saying the sentence appeared in a question and answer section of the document and was "in error." Thus the legalistic shots across the respective DOE and state bows continued, with the obvious destination being future lawsuits on the part of WIPP opponents.<sup>113</sup>

On October 30, 1997, the EPA issued its preliminary decision that WIPP was safe to open, with the final certification due in April 1998. In proposing approval of certification, the EPA in effect said the site was capable of safely shielding the environment and the public from radioactivity for 10,000 years. The EPA's tentative decision initiated four months of public comment before it could issue its final ruling. Public hearings were held in Albuquerque, Santa Fe, and Carlsbad.<sup>114</sup>

The years of argument and counter argument seemed to have confused rather than enlightened most New Mexicans. A University of New Mexico survey of public opinion about WIPP showed about 30 percent of New Mexicans thought it was still unsafe and should never open and 24 percent thought it was safe and should open. The middle 46 percent "seemed to think WIPP [could] be fixed, with major or minor changes." Long-time critic Don Hancock said the UNM survey showed "a large majority—more than 75 percent—of New Mexicans do not favor opening WIPP now because it has not been proven safe." Echoing Hancock's statement, Dennis Hurtt, a DOE official from the Carlsbad Area Office, interpreted the results as showing "the majority of residents await concrete evidence that will erase any doubt about the WIPP's



(left) The TRUPACT-II (TransUranic PACkaging Transporter) was tested at Sandia as an NRC-certified package for contact-handled TRU waste. It is a circular cylinder with a domed top. The main components are two stainless steel containment vessels, one inside the other. The outer containment vessel is surrounded by 10 inches of polyurethane foam and 1/2 inch of ceramic fiber for thermal insulation. A stainless steel shell covers the entire TRUPACT-II, which serves as a final protective structure and impact liner.

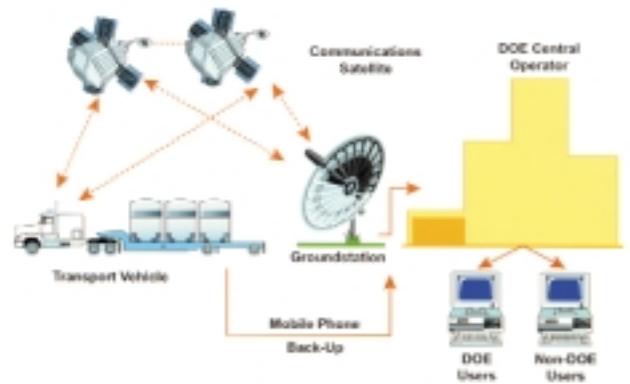


(above) Up to fourteen 55-gallon drums fit into the TRUPACT-II. The drums are banded together in groups of seven and stacked two high in the waste payload. Once inside the Waste Handling Building, the two groups of seven banded drums are removed from the TRUPACT-II package for movement to the underground disposal areas where the drums are stacked three high.

(right) TRUPACT-II packages being unloaded from a truck preparatory to being moved inside the Waste Handling Support Building. The tower in the background contains a hoist for transfer of waste to the underground disposal area.



## TRACKING SYSTEM



(above) The satellite-based tracking system constantly monitors the location of waste shipment trucks anywhere in the country.



Secretary of Energy Federico Peña visited WIPP shortly after his appointment. He was given the WIPP tour by Wendell Weart on April 19, 1997.

safety.” Larry Calloway, an *Albuquerque Journal* columnist, concluded: “Half of the people are polarized, and the other half don’t trust either side but don’t have a clue and wouldn’t want to take any chances.”<sup>115</sup>

Not taking any chances seemed to be the motivation of the Santa Fe City Council which in February 1998 rescinded an agreement it had signed four months earlier with state and federal officials restricting truckloads of radioactive material traveling through the heart of the city to certain low-traffic early-morning hours.<sup>116</sup> This decision elicited a chastising editorial in the *Santa Fe New Mexican*, which referred to the City Councilors as

...a governing body whose word is its bond—or is it a group of overgrown grade-schoolers doing their decision-making as if they were at an ice-cream store, delighting in driving the soda-jerks crazy?...[DOE] officials by now must see [it] as the latter; they’re being jerked around unmercifully....Disaster-scenarists draw gruesome scenes of glowing, Geiger-counting cylinders being hot-rodged past the homes of an unsuspecting citizenry...and something going horribly amiss. Ridiculous. Those trucks—specially built and loaded with safeguards—will be driven under scrutiny by carefully selected drivers.<sup>117</sup>

Incidentally, as of early 1998 the trucking companies under contract to DOE had been paid \$13.2 million (out of a total WIPP expenditure of about \$1.5 billion) over the previous decade “to ship—or rather, not to ship” radioactive waste to WIPP. WIPP officials defended the expense as necessary to maintain the truck drivers in readiness for the day when waste would finally be authorized for shipment to the repository. The truckers participated in emergency response drills and public relations road shows, all the while keeping themselves trained and ready to ship waste. Their training was under the supervision of state and local governments in New Mexico, Idaho, Colorado, Washington, and other states through which the waste would be trucked.<sup>118</sup> Regarding the controversy over truck shipments through Santa Fe, DOE Secretary Peña resolved it by deciding to route the trucks around the city to allay residents’ fears. “I am pleased we were able to develop this agreement,” he said. “The Department of Energy wants to be a good neighbor.”<sup>119</sup>

The WIPP achieved a significant legal and regulatory threshold when, on May 13, 1998, Peña notified Congress that the WIPP was ready to begin disposal operations. His action followed the EPA’s issuance of a certification of compliance for the WIPP that same day. Publication of the EPA certification in the Federal Register, which was expected by May 20, initiated a 30-day waiting period before WIPP shipments and disposal operations could begin. The opening date was set, as always, tentatively for June 19. Said an obviously pleased Peña: “Our action today culminates a 24-year process and marks a historic milestone in our nation’s efforts to clean up the environmental legacy of the Cold War. I am proud of this achievement....The WIPP will be the first geological repository for defense-generated radioactive waste. With the opening of the WIPP, we will be taking a substantial step forward in the environmentally safe cleanup of the nation’s former nuclear weapons production sites.”<sup>120</sup> George Dials, DOE Manager of the CAO office responsible for WIPP, announced his resignation from DOE effective at the end of May 1998, anticipating that he had accomplished his goal of seeing WIPP certified and operating.

However, the TRUPACTs were not being loaded on the trucks quite yet. Tom Udall and the environmental activists averred that the 1991 injunction from U.S. District Judge John Garrett Penn of Washington, D.C. blocking the DOE from opening WIPP without the approval of Congress or any regulatory agency was still in effect. DOE officials claimed the order was moot because Congress had since given the energy agency control of the land at WIPP; and because the EPA had issued a license for WIPP. DOE stated it planned to ship only unmixed wastes over which the state had no jurisdiction. But Udall insisted the court order was still in effect until Judge Penn lifted it. Also, he added, the New Mexico state regulators had not issued a permit for solvents and other chemical waste to be disposed at WIPP.<sup>121</sup>



So DOE moved the opening date from June 19 to August 4, which had to be postponed again until Udall's seven-year-old lawsuit was settled by Judge Penn. Thus WIPP remained at the altar as the summer of 1998 waned.

The late summer of 1998 also saw an unusual, even somewhat ironic, development in the WIPP saga. Secretary Peña had submitted his resignation in April of 1998. In July President



John Trever's wry view of the numerous postponements of WIPP's opening.

Clinton nominated long-time WIPP foe Bill Richardson to succeed Peña. Since the early 1990s when he actively opposed the WIPP land withdrawal legislation, Richardson had increasingly taken an activist and highly visible role in international affairs. As a congressman he had, on his own initiative and with Clinton's approval, traveled to various world trouble spots such as North Korea, Africa, Iraq, and Cuba to mediate disputes and help American citizens in peril. The President appointed Richardson United Nations ambassador in February 1997. Richardson served in this position until July 31, 1998, when the Senate confirmed him as Secretary of Energy. At the confirmation hearings, Senator Larry Craig, Republican from Idaho, said he would oppose Richardson's confirmation if President Clinton did not provide the Senate with a letter stating Richardson had full authority to negotiate with Congress on opening a repository at Yucca Mountain, Nevada for spent commercial reactor fuel. The status of WIPP was not raised at the hearings. However, in a get-acquainted visit to DOE employees in Washington, Richardson declared he wanted to open WIPP as soon as possible. "We think it's ready to open now," he said.<sup>122</sup>

Because WIPP had been a topic of intense public debate for 24 years, the proposed nuclear waste repository outside of Carlsbad inevitably began insinuating itself into the literary and popular culture of New Mexico. At least one con artist used WIPP to scam some gullible citizens. In 1998, Thomas Stanley Huntington of Farmington, New Mexico was convicted of selling "California Red Superworms" that, he claimed, would eat nuclear waste.

Huntington said he had a contract with WIPP to provide the worms. He sold a minimum of four pounds of worms for \$500, although some of the victims optimistically bought 10 pounds for \$1000. His scheme entailed selling the worms to people who would care for them so the worms would reproduce; then he would buy back the worms and sell them to WIPP.<sup>123</sup>

Finally, even though shipments of transuranic waste had not yet occurred by late summer of 1998, supporters of WIPP could take heart that the shipments were a *fait accompli* in fiction. Rudolfo Anaya, a University of New Mexico English professor and local novelist, wrote *Zia Summer*, a novel published in 1995 in which WIPP figured prominently. The novel served up generous amounts of local New Mexico color and politics, including UFOs, cattle mutilations, and WIPP—somehow tying these disparate topics all together. The novel's protagonist Sonny, an Albuquerque private investigator, describes Pájaro, his antagonist and anti-WIPP activist:

Sonny thought of the various groups around New Mexico that had fought the storage of nuclear waste at the WIPP site in the underground salt mines near Carlsbad. The fight had gone on for years, in the courts and out. He looked closely at the man and felt the fervor of a religious fanatic. His intense gaze reminded Sonny of pictures of saints he had seen, men burning with the divine spirit.... Eyes of the prophets of the desert, men of righteousness. Pájaro was more than a Greenie, more than an activist citizen concerned about WIPP trucks carrying nuclear waste down New Mexico roads. He was a very committed man.<sup>124</sup>

And the description of a WIPP truck is surely unlike any that ever appeared in technical reports:

Just behind the state cop, flashing yellow lights glittering in the rain, the WIPP truck appeared, a huge shadow in the mist, the huge barrel it carried rising like the hump of a prehistoric monster in the dark. Plutoniosaurus. Inside the belly of the beast lay the hot, high-level radioactive waste, now only minutes from the bridge.<sup>125</sup>

The bridge is to be sabotaged by Pájaro, whose extremist anti-WIPP alter ego is called Raven. The state police and FBI foil the scheme, with the crucial assistance of Sonny, in a dramatic shootout. Although such would not be the likely scene (especially having the truck cross a rickety wooden bridge and the erroneous reference to its carrying high-level waste) when the first shipment to WIPP rolled down the highway to Carlsbad, WIPP supporters might have received a boost from the following description:

The air was thick with a cloud of acrid smoke. The wooden bridge that once spanned the Arroyo del Sol was no more. But the WIPP truck had cleared in time and was safely rolling down the highway. Around them figures of state cops rose groaning, dusting themselves from the dirt and mud that covered them.<sup>126</sup>



The final scenario for the opening of WIPP, which would usher in a new phase when it began receiving radioactive waste, was undeniably closer at the beginning of 1999. Almost 25 years of intense scientific research and the building of a truly unique repository—an impressive technological and engineering feat in itself—had been accomplished in the face of opposition from the state, anti-WIPP organizations, and bureaucratic uncertainty and inertia.<sup>127</sup> Dedicated professionals in both Sandia and DOE could congratulate themselves for this accomplishment. Some of WIPP's opponents have been sincere in their beliefs if not always scientifically well informed. At the summing up, both the generation of Sandians and DOE scientists and administrators who labored long and hard on the WIPP and their equally dedicated opponents could say that they had the interests of the public at heart.

The finale of the first phase of the WIPP odyssey was almost anticlimactic, it occurred so quickly. On March 22, 1999, U.S. District Judge John Garrett Penn



The first shipment of TRU waste arrives at WIPP on March 26, 1999.

refused to block the shipment of radioactive waste to WIPP, opening the way for the first shipments. Judge Penn's decision was in response to a request by the state of New Mexico and four environmental groups to issue an injunction preventing the DOE from transporting 36 containers of waste to the repository until the state issued a hazardous waste permit. Judge Penn, in his ruling, also stated that WIPP has interim status as a mixed-waste facility.<sup>128</sup>

On Friday, March 26, 1999, the first truckload of TRU waste arrived at the WIPP repository in the early morning hours after a 342-mile journey from Los Alamos National Laboratory. The shipment had been scheduled to begin the previous day, but DOE officials canceled it because of a thick fog in Los Alamos. A few anti-WIPP demonstrators turned out in Los Alamos and Santa Fe, but when the inaugural TRUPACT truck reached Carlsbad the only demonstrations were from residents "welcoming the nuclear waste with open arms." Once inside the gates at WIPP, the welcome grew more enthusiastic as hundreds of sleepless workers greeted the truck's arrival. Some blew noisemakers and others chanted, "Waste in '99, it's about damn time." In a written statement, Representative Joe Skeen, a supporter of the WIPP project since its inception, stated somewhat melodramatically, "God Almighty, why did it take so long?"<sup>129</sup>

More emotionally subdued than Skeen but with evident satisfaction was Wendell Weart's reaction: "I'm ecstatic—this is just the culmination of everything I've worked for [the last] 25 years."<sup>130</sup> Asked to summarize Sandia's contributions to the WIPP project, Weart said:

We became involved in early 1975. We identified the site, then spent years in site characterization. We developed the conceptual design for the facility and prepared the first Environmental Impact Statement. We tested the TruPac *[sic]* casks that hold the waste so the NRC could certify them. Most important, we directed all of the scientific studies needed to demonstrate that wastes put into WIPP would be safe for 10,000 years. Finally, we did the performance assessment, which was the key to showing how WIPP met EPA standards. The entire application, amounting to some 80,000 pages, showed how the repository and its contents would behave over the next 100 centuries.

The road to WIPP has been long and rocky. I thank the hundreds of current, retired, and former Sandians, and a host of contractors who, together, made the trip. The quality of their work has stood the test of time and enabled us to achieve a certification that meets the EPA's very stringent rules. The site has proved to be very robust—in fact, it has been able to withstand the many regulations promulgated long after the site was first selected.<sup>131</sup>

On April 7, the second shipment passed through the gates, and a DOE spokesperson described its arrival as "routine."<sup>132</sup>



Former opponents finally united! Cutting the ribbon at the official WIPP opening ceremonies on April 17, 1999, are (left to right) Carlsbad mayor Gary Perkowski, Senator Pete Domenici, DOE Secretary Bill Richardson, Senator Jeff Bingaman, and Keith Klein, who was acting manager of DOE's Carlsbad Area Office when WIPP opened (Ines Triay was appointed manager on May 9, 1999).



Views of Bill Richardson at the WIPP opening ceremonies.

On April 17, an official ceremony was held at the WIPP site to thank all those people who worked for 25 years to see it open. DOE Secretary Bill Richardson officially opened WIPP with a congratulatory speech saying, “With New Mexico as our witness, we have truly come full circle: from generating transuranic waste to final disposal—from Los Alamos to WIPP.”<sup>133</sup> And perhaps in recognition of the irony of the situation, given his opposition in previous years to opening the repository, Richardson added: “My record on WIPP is clear—I have always insisted this facility should be opened only if scientific studies found it to be a safe and suitable repository for transuranic wastes. I believe this is a world-class facility, and the people who have worked on it are world class. After more than 25 years of road blocks, delays and hiccups, the WIPP is a success story.”<sup>134</sup>

A number of local, national, and international dignitaries attended and spoke at the WIPP opening ceremonies, among them U.S Representative Joe Skeen, Senator Pete Domenici, Senator Jeff Bingaman, and Carlsbad Mayor Gary Perkowski. The four-hour event included guided tours of surface facilities, photographic sessions for the news media and public, and interviews with early Carlsbad leaders who helped bring the WIPP to southeastern New Mexico.<sup>135</sup>

The *Albuquerque Journal*, which during 25 years had provided detailed, balanced reporting on the WIPP and its many scientific, legal, and public relations controversies, editorialized:



John Trever's final comment on WIPP



More of the headlines about one of New Mexico's longer-running controversies have been about political events than about the science and engineering that went into the \$2 billion project. Much of the political opposition—not all, but much—was aimed not at solving the problems involved in safely disposing of nuclear waste, but at obstructing disposal efforts. Many opponents care less about the safety of WIPP transport and storage than backing up radioactive wastes at temporary storage sites, blocking any further development of defense-related or peaceful uses of nuclear technology....WIPP does little to solve the problem of storing all the waste generated by the nuclear weapons complex and at power plants. It wasn't supposed to. But WIPP does much more to deal in the safest way possible with its designated waste than leaving it at sites all over the country. Taking this small step after a quarter-century of work will make it easier to take other steps necessary to clean the nation's nuclear house. Thousands more trucks will roll to the Carlsbad-area carrying plutonium-contaminated waste for burial in salt beds deep below the ground. And this week's political event will become, finally, an event as routine as the transport and storage of gasoline, chemicals and other hazardous substances people take for granted.<sup>136</sup>

The opening of the WIPP site finally resolved whether it could contribute to the national and, indeed, international goals of cleaning up the nuclear waste legacy.<sup>137</sup> It closed a chapter in the problem that the nation has faced since the end of World War II, that of disposing safely of the radioactive residue of the Cold War. The opening of WIPP initiated a new chapter and a new era.

## Epilogue—The Sultan of Salt

During his 25-year involvement with WIPP, Wendell Weart had been called many names: the Godfather of WIPP, the Grandfather of WIPP, and Mr. WIPP, among others. But one nickname stuck, in fact so well that Energy Secretary Hazel O'Leary officially designated Weart as the "Sultan of Salt" in a surprise ceremony in Washington, D.C. in 1995.

In May 1997, Weart received another, more formal title to go with the informal ones—Sandia Fellow, the highest honor bestowed on a Sandia scientist. Only two others



Wendell Weart, dressed in his official Sultan of Salt outfit, wields a scimitar at a gathering in April 1997, to honor his 35th anniversary at Sandia and his being named a Sandia Fellow, only the third in the Labs' history.

before him had achieved this distinction: renowned mathematician and cryptographer Gus Simmons and shock physics expert Walt Herrmann. In her nomination letter, Sandia vice-president Joan Woodard, wrote:

Throughout his career of more than 35 years, Wendell has made pioneering scientific contributions and has developed an extensive national and international reputation in the scientific basis for geologic disposal of nuclear waste and containment of underground nuclear explosions. He...is known throughout the international nuclear waste disposal community as a premier scientific expert.<sup>138</sup>



Wendell Weart examines a chunk of salt at WIPP. On March 26, 1999, WIPP's first waste was carried down this access drift and emplaced in the back corner of Panel 1, Room 1, signifying operation of the world's first deep underground repository for radioactive waste.

## Notes

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4. Chuck McCutcheon, "Lawmakers Tour WIPP, Seek Compromise," *Albuquerque Journal*, January 12, 1989, p. E-3.
5. Terrence R. Fehner and Jack M. Holl, *Department of Energy, 1977-1994: A Summary History* (Washington, D.C.: Department of Energy, 1994), pp. 53-54.
6. W. Keener, "Fourteen-Year WIPP Veteran Wendell Weart Fields the Questions," *Sandia Lab News*, December 22, 1989, p. 1.
7. *Ibid.*, p. 6.
8. *Ibid.*
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12. *Ibid.*, p. 191.
13. See Chapter 2.
14. Wendell Weart, written communication, November 11, 1998, WIPP Collection (WC), SCA; see also, "Cracks in WIPP Test Rooms Were Expected, DOE Says," *Albuquerque Journal*, June 4, 1989, p. A-4.
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16. "Idaho Governor Tires of WIPP Wait, Bans Waste," *Albuquerque Journal*, October 20, 1988, p. A-1.
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18. Paul R. Wieck, "DOE Nominee Boosts WIPP, Lawmaker Says," *ibid.*, February 25, 1989, p. B-3.



19. Chuck McCutcheon, "DOE Study Says WIPP Dangers Minuscule," *ibid.*, April 15, 1989, p. B-3. *See also*, *Final Supplement Environmental Impact Statement Waste Isolation Pilot Plant*, DOE/EIS-0026-FS, vol. 1, 13 volumes (Washington, DC: DOE Office of Environmental Restoration and Waste Management, January 1990), pp. 5-53 to 5-57.
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21. *Idem*, "Witnesses Berate DOE for WIPP," *ibid.*, June 16, 1989, p. A-1.
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26. *Idem*, "DOE Official Says Hearings Provide Useful Information," *ibid.*, June 17, 1989, p. B-6.
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30. *Idem*, "N.M. Senators Fight Early WIPP Start," *ibid.*, October 11, 1990, p. D-3.
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34. Parker and Landon, "Udall Tells DOE: 'See You in Court.'" "
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37. "Feds Consider Appealing WIPP Injunction," *ibid.*, November 28, 1991, p. H-3. Tom Udall (b. 1948) comes from a prominent family of liberal and environmentalist Democrats. His father Stewart Udall (b. 1920) was Interior Secretary under Presidents John Kennedy and Lyndon Johnson; he represented Arizona in the U.S. Congress from 1954 to 1960. His uncle Morris Udall (1922-1998) represented Arizona in the House (1961-1991) and made a bid for the presidency in 1976. In 1998, Tom Udall was elected U.S. Representative from New Mexico.
38. Chuck McCutcheon, "Watchdog Group Criticizes Test Plan," *Albuquerque Journal*, February 4, 1992, p. A-3. *See also*, Lokesh Chaturvedi and Matthew K. Silva, "An Evaluation of the Proposed Tests with Radioactive Waste at WIPP," in *High Level Radioactive Waste Management, Proceedings of the Third Annual International Conference*, volume 1, (New York: American Nuclear Society/American Society of Civil Engineers, 1992), pp. 600-609.

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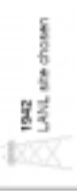



# **APPENDIX A**


## **Historical Timeline of the WIPP Project**









**Rob P. Rechard**



# Milestones for Disposal of Radioactive Waste in the United States

| Time Line | Noteworthy Events   | Technical Milestones Related to the WIPP   | U.S. President and DOE Directives and Decisions   | Federal Legislation, Judicial Decisions, and Regulatory Requirements Related to Nuclear Waste Disposal   | New Mexico Administration, Regional Issues, and Legal Challenges |
|-----------|---|--|---|--|--|
| 1942      |    | <ul style="list-style-type: none"> <li>1942 - All types of waste initially dumped in canyons at Los Alamos National Laboratory (LANL).</li> </ul>  | <ul style="list-style-type: none"> <li>1942 - Manhattan Engineering District (MED) Corps of Engineers selects site for LANL to develop a nuclear bomb.</li> </ul>                                       |  | Miles Admin.   |
| 1943      |    | <ul style="list-style-type: none"> <li>1943 - Plutonium operations commence and disposal of nuclear waste begins on site at Oak Ridge National Lab (ORNL) in trenches and Clinch River. Water has saturated the bottoms of some trenches, and migration of radionuclides has been observed.</li> </ul>   | <ul style="list-style-type: none"> <li>1943 - MED's outfall decision on managing waste: store high-level waste (HLW) as liquids in tanks and bury other waste (solid or liquid) in trenches.</li> </ul> |  |  |
| 1944      |   | <ul style="list-style-type: none"> <li>1944 - Disposal of nuclear waste begins on site at LANL (using trenches, ponds, sugarbeet) and Hanford Reservation (using salt-road cuts, trenches, ponds, tanks, underground cisterns).</li> </ul>   |   |  | Dempsey Administration   |
| 1945      |    | <ul style="list-style-type: none"> <li>1945 - Atomic bomb exploded at Trinity Site near Alamogordo, NM.</li> </ul>   |   |  |  |
| 1946      |   |  | <ul style="list-style-type: none"> <li>1946 - Atomic Energy Commission (AEC) Chairman L. R. Berkeley (Director of Tennessee Valley Authority)</li> </ul>  | <ul style="list-style-type: none"> <li>1946 - Atomic Energy Act (AEA) of 1946:               <ul style="list-style-type: none"> <li>creates AEC</li> <li>establishes government monopoly on atomic weapons and nuclear material</li> </ul> </li> </ul> | Mabry Admin.   |
| 1949      |   |  | <ul style="list-style-type: none"> <li>1949 - Truman asks AT&amp;T to manage the recently formed Sandia Laboratory.</li> </ul>  |  |  |
| 1951      |   |  |   |  |  |
| 1952      |   |  |   |  |  |
| 1953      |   | <ul style="list-style-type: none"> <li>1952 - Idaho National Engineering and Environmental Lab (INEEL) completes Radioactive Waste Management Complex (RWMC) for storing and burying waste; migration of radionuclides downward into the alluvium has been observed.</li> <li>1953 - Savannah River Plant (SRP) begins waste storage and disposal on site at "Old Burial Ground" under in trenches from precipitation has caused migration of radionuclides.</li> <li>1954 - Rocky Flats Plant near Denver, CO, begins shipping transuramics (TRU) waste to INEEL for disposal of RWMC.</li> </ul> | <ul style="list-style-type: none"> <li>1953 - AEC Chairman: Strauss</li> </ul>  |  | Mechem Administration  |
| 1955      |   |  | <ul style="list-style-type: none"> <li>1955 - AEC asks National Academy of Sciences (NAS) to examine issue of permanent disposal of radioactive wastes.</li> </ul>                                      | <ul style="list-style-type: none"> <li>1954 - AEA of 1954 seeks peaceful uses of atomic energy, thus allows regulated private atomic energy development.</li> </ul>  | Simms Admin.   |
| 1957      |  | <ul style="list-style-type: none"> <li>1957 - NAS recommends radionuclide waste disposal in salt as most promising method. ORNL begins research in salt (1957-61). May: Rocky Flats Plant catches fire but kept secret.</li> </ul>   | <ul style="list-style-type: none"> <li>1957 - Plowshare program starts to look at peaceful uses of nuclear explosives.</li> </ul>   |  | Mechem Admin.  |
| 1959      |   | <ul style="list-style-type: none"> <li>1959 - NAS commission an oceanography reports on coastal disposal of low-level radioactive waste.</li> </ul>  |   |  | Burroughs Admin.   |
| 1960      |   |  |   |  |  |

|      |   |  |  |   |   |                         |
|------|---|--|--|---|---|-------------------------|
| 1961 |    | <p>★ 1961 - Dec: NAs reaffirms use of New Mexico salt beds for disposal. US Geological Survey (USGS) evaluates stratigraphy and AEC mines into Salado Fm. at Gnome site near Carlsbad, NM, for Gnome test as part of Powdermill program.</p>   | <p>● 1961 - AEC Chairman: Seaborg (co-discoverer of Pu)</p>  | Kennedy Administration  |   | Mechem Admin.           |
| 1962 |   | <p>● 1962 - USGS reports on domestic salt deposits suitable for waste disposal: the Permian Basin in parts of NM, KS, TX, and OK is one area identified.</p>   |  |   |   | Bolack Admin.           |
| 1963 |    | <p>★ 1963 - ORNL begins Project Salt Vault, a large-scale field test in which irradiated fuel elements and electric heaters are placed in an existing salt mine at Lyons, KS; up to 1967, the tests primarily study near-field effects. INEEL adopts oxidation of liquid HLW to form solid grains ("calcine") for storing HLW.</p> |  |   |   | Campbell Administration |
| 1965 |   | <p>● 1965 - Savannah River Plant (SRP) begins disposing TRU waste in trenches on site.</p>   |  |   | <p>● 1966 - Jan: B52 collides with refueling tanker at 30,500 ft.; three nuclear weapons crash into Spanish sea; fourth weapon parachutes into ocean. (Question raised as to how much plutonium-contaminated soil to return to Savannah River Plant).</p> |                         |
| 1966 |   | <p>● 1966 - NAs reaffirms use of salt beds for disposal and strongly criticizes current disposal practices.</p>  |  |   |   |                         |
| 1967 |   |  |  | Johnson Administration  |   |                         |
| 1968 |   | <p>● 1968 - Committee on Radioactive Waste Management established by NAS, later permanent "Board" (BRWM); first task is to reevaluate the use of bedded salt.</p>  | <p>● 1968 - AEC asks NAs to revisit the issue of nuclear waste disposal. At request of Congress, General Accounting Office (GAO) audits AEC waste management practices and finds faults with records and management. AEC forms task force to address criticisms.</p>   |   |   |                         |
| 1969 |   | <p>★ 1969 - May: Rocky Flats Plant catches fire and cleanup waste sent to Idaho for disposal at RWMC; event focuses public attention on AEC nuclear waste problems. International Atomic Energy Agency (IAEA) forms advisory committee to categorize nuclear waste. All pre-contaminated waste one category defined.</p>           | <p>★ 1969 - Dec: Congress passes National Environmental Policy Act (NEPA); requires federal agencies to consider environmental consequences of any major action through environmental impact statement (EIS)</p> <p>- first US environmental law to be applied to the Waste Isolation Pilot Plant (WIPP) public comment provides avenue for groups to push for stringent regulations for nuclear facilities.</p> |   |   | Cargo Administration    |
| 1970 |  | <p>★ 1970 - Conceptual design completed for HLW repository in salt. New BRWM of NAs issues report concluding bedded salt salt-factory and safest choice now available for nuclear waste disposal.</p>  | <p>★ 1970 - Mar: AEC Chairman: Schlesinger. AEC directs TRU waste be stored nonhazardously at all DOE facilities rather than disposed with low-level waste. (AEC tells Sen. Church that the waste stored at INEEL will be removed by 1980 and sent to salt mine. AEC tentatively selects mine in Lyons, KS, as repository.)</p>  | <p>★ 1970 - Congress forms Environmental Protection Agency (EPA) and transfers to it research, monitoring, standard setting, and enforcement activities related to environment. AEC conservatively bounds TRU waste as waste contaminated with transuranic radionuclides with activity greater than 10 nCi/g.</p> |   |                         |
| 1971 |  | <p>● 1971 - Many drill holes and some solution mining discovered at Lyons, KS. USGS tests permeability of strata around Gnome site (Powdermill program) for closure studies by AEC.</p>  | <p>● 1971 - AEC states all commercially generated HLW must be solidified within 5 yr and delivered to a federal repository within 10 yr.</p>   | <p>● 1971 - Congress directs AEC to stop Lyons project until safety is certified. Appeals court requires AEC to look at all environmental impacts in EIS.</p>   |   | King Admin.             |

| Time Line | Noteworthy Events   | Technical Milestones Related to the WIPP   | U.S. President and DOE: Directives and Decisions   | Federal Legislation, Judicial Decisions, and Regulatory Requirements Related to Nuclear Waste Disposal   | New Mexico Administration, Regional Issues, and Legal Challenges   |
|-----------|---|--|--|--|--|
| 1972      | 1972 Lyons site judged unsuitable<br>  |  | ★ 1972 - May: AEC abandons Lyons project. AEC announces plans for Paducah Surface Storage Facility (PSSF) for radioactive wastes. AEC Chairman asks for Probabilistic Risk Assessment (PRA) of core meltdown.  | ● 1972 - EPA and anti-nuclear groups claim RSSF de facto permanent disposal in RSSF EIS.   |  |
| 1973      | 1973 Carbide location chosen<br>   | ★ 1973 - Nationwide search for suitable salt site resumed. AEC, USGS, and ORNL recommended southeastern NM (back of border) 2 miles from site important selection criterion but reduced to 1 mile in 1976).  | ● 1973 - AEC Chairman: D.L. Ray  |  | ● 1973 - With tacit approval of Gov. King, local political leaders and private mine operators invite AEC to southeastern NM. (This strong local and political support from southeastern NM facilitates the WIPP process.) Oct: Arab oil embargo against U.S. |
| 1974      | 1974 Draft of 1st PRA on nuclear reactors<br><br>1974 ORNL conducts scenario development and consequence analysis of WIPP<br>   | ★ 1974 - Mar: ORNL begins field investigations for the Booked Salt Plant (BSPP) by drilling AEC-7 and AEC-8. Aug: Draft of first major Probabilistic Risk Assessment (PRA) published on two reactors by 60 member team for Nuclear Regulatory Commission (NRC); method uses fault trees to synthesize probability of total system failure. Oct: ORNL conducts first scenario development and consequence analysis for WIPP. Probability of meltdowns impact, probability of fault (and volcanism), and exploratory drilling intersecting disposal area estimated.  | ● 1974 - AEC promises Idaho that wastes will be shipped in the 1970s. May: WIPP work suspended until 1975 because AEC wishes to emphasize RSSF and AEC Chairman Ray will not withdraw land from oil exploration because of oil embargo.  | ● 1974 - Oct: Energy Reorganization Act splits AEC into Nuclear Regulatory Commission (NRC) and Energy Research and Development Agency (ERDA) effective January 1975.  | ● 1974 - Gov. King establishes Governor's Technical Excellence Committee, creates WIPP oversight subcommittee.   |
| 1975      | 1975 WIPP moved toward beam center<br>   | ★ 1975 - Mar: Sandia National Laboratories (SNL) receives funding and starts four tasks: selecting site and characterizing, producing conceptual design, drafting EIS, initiating scientific studies. May: ERDA-6 drilled at NW corner of original ORNL site, encounters deformed salt beds and hits brine and H <sub>2</sub> S much deeper. SNL recommends relocation and project moves site ~11 km (7 mi) toward center of Delaware Basin to avoid deformed salt beds as indicated by oil well logs. SNL begins screening grounds to use for plugging boreholes. | ● 1975 - Jan: ERDA asks SNL, located in NM, to oversee investigations rather than ORNL and suggests an opening date of 1982. ERDA removes WIPP from commercial repository program.   | ● 1975 - NRC promulgates "As Low As Reasonably Achievable" (ALARA) policy for limiting radiation exposure. Oct: NRC final PRA for nuclear reactors.  | ● 1975 - AG: Analysis.   |
| 1976      | 1976 ERDA-4 drilled at center of WIPP site<br><br>1976 Ford orders demonstration of nuclear waste disposal<br><br>1976 Sandia Lodge Conference for geologic disposal<br> | ★ 1976 - SNL begins site characterization and engineering design program at new site, with various natural backfills such as apatite or salt bentonite considered for use in repository. Parsons, Brinckerhoff, Quade, and Douglas, Inc. describe hypothetical HLW repository in bedded salt for Office of Nuclear Waste Isolation of ERDA. Apr: ERDA-9 drilled into Cambria Formation near center of new site. Laboratory tests on TRU waste behavior and HLW packages initiated.   | ★ 1976 - Jan: Project is officially named the "Waste Isolation Pilot Plant." Oct: Ford orders major expansion of ERDA program to demonstrate permanent disposal for nuclear waste by 1985 and orders EPA to develop generally applicable standards. ERDA funds conference on modeling of geologic disposal systems to bring engineers and geologists together to explore predicting geological features, events, and processes (FEPs). | ● 1976 - Resource Conservation and Recovery Act (RCRA) seeks to reduce or eliminate hazardous waste generation to minimize present and future threat to human health and environment. Dec: EPA announces intent to develop radiation protection standards for HLW disposal. NRC funds panel of earth scientists to identify events and processes that could disrupt a geologic repository. |  |



|  |  |  |  |
|--|--|--|--|
| <p><b>1977</b> WIPP conceptual design with two levels</p>               | <p><b>1977 - Jun:</b> SNL issues conceptual design report of WIPP repository with two levels. WIPP conceptual design report issues. SNL, EPA, DOE, and NM begin planning for siting. SNL, EPA, DOE, and NM begin planning for siting. SNL, EPA, DOE, and NM begin planning for siting.</p> | <p><b>1977 - Oct:</b> DOE Organization Act creates cabinet-level Department of Energy (DOE) from EROA. Feb: In response to DOE's directive, EPA conducts first public workshop to understand public concerns and technical issues of waste disposal. Apr: Second meeting of NRC panel of earth scientists occurs to identify events and process.</p>   | <p><b>1977 - NM Hazardous Waste Act</b> seeks to maintain environmental quality.</p>   |
| <p><b>1978</b> SNL publishes DOE report on WIPP repository design</p>   | <p><b>1978 - Jan:</b> SNL publishes DOE report on WIPP repository design. DOE report on WIPP repository design. DOE report on WIPP repository design.</p>  | <p><b>1978 - Jan:</b> EPA announces public forum to develop protection criteria for radioactive wastes. Nov: EPA publishes "Criteria for Radioactive Wastes" as guidance for federal agencies and seeks comments.</p>  | <p><b>1978 - DOE</b> contracts with NM to establish Environmental Evaluation Group (EEG) to provide a full time, independent assessment of WIPP and oversee environmental, public health and safety. Although DOE-funded, EEG is initially made a part of the Environmental Improvement Division of the NM Health &amp; Environment Department. The general understanding is neither DOE nor NM would attempt to bias or interfere in EEG's technical conclusions. EEG becomes second permanent outside oversight group set up by DOE (first was NRC WIPP Panel of BRWM). NM House almost passed bill proposal for constitutional amendment to keep nuclear waste from NM.</p> |
| <p><b>1979</b> SNL publishes DOE report on WIPP repository design</p>   | <p><b>1979 - May:</b> SNL publishes DOE report on WIPP repository design. DOE report on WIPP repository design. DOE report on WIPP repository design.</p>  | <p><b>1979 - May:</b> House Armed Services Committee cuts WIPP funding in response to O'Leary's (DOE's) expansion of the project to a repository for commercial SNF and thus requiring NRC licensing (even if for demonstration only). Dec: Congress defines mission of WIPP:</p> <ul style="list-style-type: none"> <li>- sets up WIPP as a research and development facility for disposal of only TRU radioactive waste from DOE facilities</li> <li>- exempts WIPP from NRC licensing</li> <li>- requires DOE to sign a "Consultation &amp; Cooperation" (C&amp;C) Agreement with NM. EPA defines TRU waste as waste with activity greater than 100 nCi/g.</li> </ul> | <p><b>1979 - AG</b> Benjamin. Legislative establishes (1) Governor's Radioactive Waste Consultation Task Force to negotiate with DOE and (2) Legislative Radioactive and Hazardous Materials Committee to review task force.</p>   |
| <p><b>1980</b> SNL publishes DOE report on WIPP repository design</p>  | <p><b>1980 - Jan:</b> SNL publishes DOE report on WIPP repository design. DOE report on WIPP repository design. DOE report on WIPP repository design.</p>  | <p><b>1980 - Jan:</b> EPA announces public forum to develop protection criteria for radioactive wastes. Nov: EPA publishes "Criteria for Radioactive Wastes" as guidance for federal agencies and seeks comments.</p>  | <p><b>1980 - NM Hazardous Waste Act</b> seeks to maintain environmental quality.</p>   |









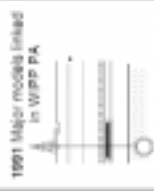
| Time Line | Noteworthy Events  | Technical Milestones Related to the WIPP   | U.S. President Directives and Decisions   | Federal Legislation, Judicial Decisions, and Regulatory Requirements Related to Nuclear Waste Disposal  | New Mexico Administration, Regional Issues, and Legal Challenges   |
|-----------|--|--|---|---|--|
| 1980      | 1980 First EIS on WIPP<br>  | ● 1980 - Westinghouse completes first Safety Analysis Report (SAR). General Atomic Technologies started as A/E for TRUPACT-I (used SNL basic concept but changed details). SNL asked to analyze and test TRUPACT-I when built.   | ★ 1980 - Feb: Carter orders SNF repository to stop. Mar: Carter releases 1980 funds for WIPP and announces interim strategy to set aside money for possible future waste disposal projects at WIPP. Oct: DOE issues final EIS withdrawing SNF and HLW disposal and then by reinstates WIPP mission defined by Congress in 1979. Nov: DOE applies to Department of Interior (DOI) for administrative withdrawal of land for Site and Preliminary Design Validation (SPDV) experiments at WIPP. | ● 1980 - Jul: House Armed Services Committee disapproves with Carter proposal; therefore, restricted funds are returned to WIPP mid-year.   | ● 1980 - NM and DOE begin negotiations on C&C Agreement to define procedures and process of cooperation.   |
| 1981      | 1981 First shaft drilled<br>1981 SNL reports on PA of hypothetical salt site<br>1981 Stipulated agreement between DOE and New Mexico signed<br> | ★ 1981 - Tests begun in nearby potash mine, Mississippi Chemical Mine Co., to evaluate corrosion of potential waste casks and overpack alloys. May: WIPP begins augmenting for first shaft, which is used in SPDV phase of WIPP. Forth & Schloss, SPDV construction contractor, begins augmenting first shaft (this exploratory shaft later called construction and salt handling shaft). June: Drilling of second 3.6 m shaft begins (this waste shaft initially called ventilation shaft). July: Drilling on first shaft begins. Stipulated Agreement (SA) between New Mexico and DOE describes disruptive scenarios (e.g., breccia pipe, salt dissolution, and salt deformation) that are to be dismissed through further site characterization. Oct: First 3.6 m shaft completed. Nov: Project strikes presumed brine reservoir while deepening Wipp-12 north of the repository (as part of Stipulated Agreement (SA)). Extensive tests and analyses continue on Wipp-12 through 1983. Three tests set up in nearby Mississippi chemical potash mine to evaluate fluid migration in salt formations. Dec: Drilling of second shaft begins. Draft of final report to NRC on performance assessment (PA) of hypothetical bedded salt repository readily available - uses a set of loosely connected codes, precursors to SWIFT II (fluid flow code), and NEPTUN (network transport code). IAEA recommends procedure for PA and potential list of events and processes for scenarios. | ● 1981 - Jan: DOE publishes Record of Decision to proceed with SPDV phase. Feb: After reviewing preliminary design, DOE delays detailed (Title II) design phase. DOE Sec: Edwards. June: DOE WIPP Project Mgr. McDough reiterates disagreements between DOE and New Mexico by stating HLW could be placed by 1983 and remain during the operating phase of WIPP. Sept: After reviewing preliminary design, DOE delays detailed design phase.  | ● 1981 - Jan: NRC promulgates licensing procedures for SNF and HLW disposal in geologic repositories. District Court denies Citizens for Alternatives to Radioactive Dumping (CARD) motion for a preliminary injunction against constructing WIPP. Draft (but not final) Nuclear Waste Policy Act (NWPA) defines TRU waste as waste contaminated with transuranic radionuclides with half-life greater than 20 yr and activity greater than 100 nCi/g. Mar: Developing generic disposal criteria for radioactive wastes is difficult, thus EPA starts developing standards for each waste type. | ★ 1981 - Jan: In response to Record of Decision DOE proceeds with SPDV.<br>● Mar: CARD files lawsuit and asks for preliminary injunction.<br>● May: NM AG sues DOE and DOI alleging violations of federal and state laws.<br>● July: Southwest Research and Information Center (SWRIC) files lawsuit and begins strategy of filing numerous interrogatories to which DOE must respond.<br>In response to lawsuits, DOE Sec. Edwards visits NM talks to Gov. King and accedes to a Stipulated Agreement (SA) to demands for (1) geotechnical experiments, (2) SNL report on 17 technical issues (e.g., disruptive scenarios such as breccia pipe, salt dissolution, and salt deformation) that are to be examined by SNL, (3) state and public review of WIPP issues (e.g., emergency response and issues (e.g., emergency response and highway upgrades). C&C Agreement attached as Appendix A. Working Agreement as Appendix B. U.S. Dist. Judge Rumsige stays lawsuit in accordance with SA. Coalition for Direct Action at WIPP demonstrates against construction. EEG recommends relocating TRU storage away from WIPP-12. |



| 1982  | SPDV  | Disposal System Characterization   | Reagan Administration  | King Administration   | Anaya Administration   |
|---|---|--|--|---|--|
| <p>1982 USGS dismisses concerns about breach pipes</p>  <p>1982 Disposal area moved to south of shafts</p> | <p>★ 1982 - Mar: Second 1.6 m shaft completed (~80 m 270 ft) of drilling fluid left in the shaft. Westinghouse suggests eliminating fourth shaft along with other cost saving measures. May: Repository level selected. June: Army Corps of Engineers assumes responsibility for all phases of construction management. July: Drilling of DOE-1 started and completed to top of Arroyo Culebra. Oct: Underground excavation started to connect the two shafts. Nov: Excavations connect the two existing shafts. Following evaluation of WIPP-12, TRU disposal area moved ~1800 m (6000 ft) south (experimental area left in original area). Schedule calls for opening WIPP in April 1989. Final shaft sealing concepts presented. SNL publishes report outlining in situ tests to perform in next several years. Dec: SNL completes interim report on dissolution of evaporites in and around the Delaware Basin (part of SA). USGS completes breach pipe report (part of SA) and dismisses concerns.</p> | <p>★ 1983 - Mar: SNL, USGS, and contractors complete most reports required by SA (e.g., USGS reports Culebra transmissivity at 20 locations; SNL reports on groundwater flow in Rustler Fm. and deformation of evaporites near WIPP; technical support contractor, Westinghouse, reports on brine reservoirs in the Culebra Fm.). Excavation of experimental rooms begins, and Bechtel begins final (TRU II) design. April: WIPP Panel NAS tours WIPP underground to examine SPDV tests. May: Repository level selected. Oct: Drilling of pilot hole for third shaft begins (exhaust shaft) and is completed in December. Aug: Disposal of Culebra Buby started and completed to Bell Canyon Fm.; geophysical logs run and deep sandstones in Bell Canyon hydrologically tested.</p> | <p>1983 - DOE Sec. Heide. Mar: DOE gives SPDV reports to NM and allows 60-day comment period. In response to questions by EEG, DOE concludes draft 40 CFR 191 applies to disposal phase but not test phase of WIPP. May: ORNL complex admits releasing 2 x 10<sup>10</sup> lb of Hg from Y-12 plant between 1950 and 1977. Reregulation prompts Natural Resources Defense Council (NRDC) and Legal Environmental Assistance Foundation (LEAF) to sue DOE. July: DOE announces decision to proceed with construction. Sept: DOE sets Oct 1988 as WIPP opening date.</p> | <p>1982 - Dec: Supplemental SA signed (1) committing DOE to seek funds for upgrading highways in NM, (2) committing DOE to more geotechnical studies, and (3) making DOE liable for WIPP-related accidents.</p> <p>1982 - Courts decline to relieve DOE from responding to numerous SWERC interrogatories. Mar: DOI approves DOE's application for administrative withdrawal of 36 x 10<sup>6</sup> m<sup>2</sup> (8500 acres) for conducting SPDV experiments for 8 yr. Dec: NWPA passed; sets up trust fund, funded by utilities, to pay for SNF and HLW repository - requires NRC licensing of repository - sets acceptable risk of 1000 deaths/10,000 yr - states SNF and HLW from DOE facilities will go to repository unless President objects - suggests DOE build Monitored Retrievable Storage (MRS) Facility - EPA publishes working draft 20 of environmental standards for radioactive waste management as proposed 40 CFR 191.</p> | <p>1983 - AG: Bardacke. May: After reviewing results from SPDV program, EEG concludes that "...the Los Medanos site has been characterized in sufficient detail to warrant confidence in the validation of the site for permanent emplacement of approximately 6 million ft<sup>3</sup> (1.75 x 10<sup>8</sup> m<sup>3</sup>) of defense TRU waste," but also recommends additional studies to resolve outstanding geotechnical issues such as evaluation of potential for brine reservoirs. Aug: EEG issues report and Governor holds press conference on concern about potentially explosive hydrogen gas in THURPACT-I. Sept: CARD and Sierra Club allege that DOE and EEG are collaborating to deceive NM about safety of WIPP. They also insist on NRC licensing of WIPP.</p> |
| 1983  | <p>1983 Full construction begins</p>   |  |  | <p>1983 - Congress allocates \$5.6 M for road improvement in NM. Jan - Sept: EPA's Science Advisory Board (SAB) holds public meetings on 40 CFR 191. June: DOI approves land withdrawal for 8 yr for a 36 x 10<sup>6</sup> m<sup>2</sup> area to conduct WIPP. NRC promulgates technical criteria for waste disposal in geologic repositories and includes by reference the yet-to-be promulgated EPA standard on waste disposal.</p>   | <p>1983 - AG: Bardacke. May: After reviewing results from SPDV program, EEG concludes that "...the Los Medanos site has been characterized in sufficient detail to warrant confidence in the validation of the site for permanent emplacement of approximately 6 million ft<sup>3</sup> (1.75 x 10<sup>8</sup> m<sup>3</sup>) of defense TRU waste," but also recommends additional studies to resolve outstanding geotechnical issues such as evaluation of potential for brine reservoirs. Aug: EEG issues report and Governor holds press conference on concern about potentially explosive hydrogen gas in THURPACT-I. Sept: CARD and Sierra Club allege that DOE and EEG are collaborating to deceive NM about safety of WIPP. They also insist on NRC licensing of WIPP.</p> |
| 1984  | <p>1984 SNL begins building many underground experiments</p>   |  | <p>1984 - Mar: Manager of Albuquerque Operations Office (AL) moves WIPP Project Office (WPO) to Carlsbad.</p>  | <p>1984 - Feb: EPA SAB endorses probabilistic approach of 40 CFR 191 but states performance criteria too restrictive and recommends several changes. April: LEAF vs. Heide requires DOE to apply both the technical and procedural requirements of RCRA to DOE facilities even though AEA exempted DOE from many environmental and human health laws. Nov: Hazardous and Solid Waste Amendments (HSWA) to RCRA ban land disposal of hazardous waste without treatment unless disposal site and generator demonstrate "no migration" of constituents for as long as waste remains hazardous.</p>   | <p>1984 - Nov: First modification to CAC Agreement limiting remote handling (RH) TRU waste amount to 5.1 x 10<sup>6</sup> Ci.</p>  |





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|-----------|--|---|---|--|--|
| 1985      |  <p>1985 EPA promulgates 40 CFR 191</p>  <p>1985 SNL reports on creep rate discrepancy in creep test decreased in 1982</p> | <p>★ 1985 - Jan: Blasting of trial shaft to final 4.6 m diameter completed. Excavation begins for circular room H. SNL reports on discrepancy between measured and predicted salt creep first observed in south drift in 1982. General Atomic Technologies disassembles THRAPACT-4 and sets out in half with odor result, while rebuilding, puncture damage replicated to match damage in original THRAPACT-4. With the definition of a 5-km boundary to the disposal system in 40 CFR 191, project begins to focus more on near-field hydrologic modeling rather than regional modeling. Apr &amp; Oct: SNL turns on heat for simulated defense high-level waste (DHLW) container experiments.</p>   | <p>● 1985 - DOE Sec. Harnington. President approves the three repository candidates as recommended by DOE for SNF and HLW. President concurs with DOE recommendation that defense SNF and HLW be disposed of in commercial repository. Note: DOE attempts to define "by-product material" to include mixed waste and thus exclude EPA regulation.</p> | <p>★ 1985 - Office of Technology Assessment (OTA), an agency of Congress, concludes no insurmountable technical obstacles for geologic repositories. Steps: EPA promulgates 40 CFR 191 for disposal of SNF, HLW, and TRU in a geologic repository; probabilistic criteria indirectly based on population health risk; requests inclusion of all uncertainty in 40 CFR 191. EPA defines TRU waste as waste with activity greater than 100 nCi/g and half-life greater than 20 yr. Promulgation begins the transition of the WIPP to compliance phase.</p> | <p>● 1985 - Jan: NM receives EPA authorization to regulate hazardous wastes. Feb: Natural Resources Defense Council (NRDC) sues EPA to issue 40 CFR 191 as mandated in NWPA of 1982. EEG notifies DOE that the single-shelled, vented rectangular transportation container for TRU waste, TRUPACT-1, is unacceptable for NM.</p>   |
| 1986      |  <p>1986 EPA states mixed waste subject to RCRA (voluntarily WIPP waste)</p>  | <p>● 1986 - Feb: Pillar creep test begins in circular room H. Healed (accelerated) leaks of CH-TRU and HI-TRU container behavior start. THRAPACT-4 plastic freestill at SNL. First in situ injected brine flow measurement to determine permeability around drifts. Oct: In preparation for operations, Westinghouse awarded Management &amp; Operation (M&amp;O) contract. Army Corps of Engineers relieved of construction management duties.</p>   | <p>● 1986 - Aug: DOE asks SNL to assess performance of WIPP against 40 CFR 191 criteria (Performance Assessment [PA]). SNL accepts PA task.</p>   | <p>★ 1986 - EPA states that mixed waste (radioactive waste also meeting hazardous waste definition) is subject to RCRA and hazardous waste regulations. NRC promulgates probabilistic safety goals for nuclear reactors that are similar to 40 CFR 191.</p>  | <p>● 1986 - Mar: NRDC and others sue EPA over groundwater and individual protection standards in 40 CFR 191.</p>   |
| 1987      |  <p>1987 Brine pockets cannot be damaged</p>  | <p>★ 1987 - SNL finds possibility of a pressurized brine reservoir below the TRU disposal area cannot be ruled out. Lack of double containment in THRAPACT-4 becomes major issue. Well salt compaction tests concluded, constitutive equation for consolidation developed, and shaft consolidation modeled (effective consolidation predicted in &lt; 100 yr). Mar: SNL finds that porous media flow assumption inadequately models flow in Culbrena at H-3 but that transport is best modeled as dual porous media (though roughly approximated as equivalent porous media). Modeling with variable brine densities suggests Culbrena acting as leaky confined aquifer; subsequent models ignored suggestion until 1997. Also model suggests highly transmissive zone in the Culbrena to the south of H-11 and DOE-1. Oct: Nuclear Packaging becomes AIE for the Transuranic Package Transport design II (THRAPACT II); SNL again selected as DOE technical advisor.</p> | <p>● 1987 - May: DOE redefines "by-product material" to exclude everything except radionuclides, and thereby TRU waste is subject to RCRA (and HSWA). Jul: Agreement between Department of Labor (DOL) and DOE on mine inspections. Oct: DOE selects Nuclear Packaging conceptual design for THRAPACT-II.</p>   | <p>● 1987 - June: In response to legal challenges to individual and groundwater protection requirements in Subpart B, Court of Appeals for First Circuit in Boston vacates and remands all of 40 CFR 191 to EPA. Sept: Court reinstates Subpart A of 40 CFR 191 in response to EPA request. Dec: Nuclear Waste Policy Amendments Act (NWPA) selects Yucca ML, NV, to undergo site characterization for potential SNF and HLW disposal, because bedrock salt not being considered. SNF and HLW tests at WIPP unnecessary.</p>                             | <p>Camuthers Administration</p> <p>● 1987 - AG. Stanton. Anticipating conflicts between radioactive and hazardous waste regulations, NM legislature considers WIPP from hazardous waste regulations. Aug: second modification to C&amp;C Agreement committing DOE to comply with all applicable laws and regulations, and discourage WIPP compliance by way of grandfathering, variance, exemption, or waiver, and cite 40 CFR 191 as first issued for evaluating WIPP compliance until released by EPA, NRC and Department of Transportation (DOT). Environmental groups also concern of brine seepage into repository.</p> |


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| <p>1968 Brine seepage into WIPP big issue</p>  | <p>1968 Draft Supplemental EIS identifies gas generation as issue</p>  | <p>1969 Berlin Wall falls</p>  | <p>1969 Demo for WIPP PA</p>  | <p>1968 - May: WIPP begins drilling fourth shaft (air intake shaft) after reevaluating 1962 decision to eliminate it. Sept: SNL reports on in situ permeability (1000 times lower than 1970) and small potential brine inflow. Members of NAS BRWM (not WIPP Panel) study brine inflow, conclude no problem but suggest brine inflow test and less waste be used for pilot phase. First prototype of TRUPACT-II passes structural tests, but fails engulfing the test at seals. SNL begins work on CAMCON to link detailed consequences models in probabilistic PA. SNL also simultaneously begins work on prototype of CAMCON to meet Dec. 1969 deadline. SNL completes pumping tests at H-11 and begins using results to calibrate regional flow model.</p> | <p>1968 - Sep: DOE announces that WIPP will not open as scheduled in Oct. Dec: DOE disavows contract SNL and HLW experiments because of NWPAA (no funds available to remove and examine annular disposal containers).</p> | <p>1969 - DOE Sec: Wilkins. Jan: DOE files request for administrative withdrawal of 16 m<sup>3</sup> with DOI (less than half of land allowed by 40 CFR 191). Mar: DOE issues Draft Supplemental EIS. Wilkins creates "Blue Ribbon Panel" to examine WIPP readiness. Jan: Wilkins announces an indefinite delay in opening of WIPP. Wilkins creates "Tiger Teams" to examine environment, safety, and health issues throughout DOE defense complex.</p> | <p>1969 - Aug: NRC approves the pressurized transportation container for shipping contact-handled (CH) TRU to TRUPACT-II.</p> | <p>1969 - Jan: EEG issues report on potential brine reservoirs under WIPP. DOE, Idaho Gov, Andrus bans shipments of radioactive waste into state because WIPP not open. Dec: ID Gov. Andrus, CO Gov. Romer, and NM Gov. Conditians meet in Salt Lake City to discuss WIPP and options to avert shutdown of DOE Rocky Flats Plant from lack of storage authorized by CO, and inability to ship to ID because of imposed ban by Gov. Andrus; DOE agrees to vigorously pursue both administrative and legislative lead withdrawn at for WIPP.</p> | <p>1969 - Legislature unanimously removes "WIPP exemption" in hazardous waste laws so EPA will grant authority to regulate radioactive mixed waste. Nov: Berlin Wall falls signaling the end of the Cold War and greatly changing future demands for nuclear weapon material and, thus, amount and composition of TRU waste going to WIPP.</p> |
| Full Construction Phase   |   |   |  |   | Bush Administration   |   |   |  |  |
| Compliance Evaluation   |   |   |  |   | Carnuthers Administration   |   |   |  |  |

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|-----------|--|--|--|--|--|
| 1990      | <p>1990 Construction officially complete</p>  <p>1990 Final full PA of WIPP (1989 PA was draft) also CAMCON</p>  | <p>★ 1990 - Jan: Construction officially complete. SNL and Westinghouse complete report on the pilot test phase of WIPP suggesting that a waste amount equal to 0.5% of capacity be brought to WIPP for gas generation experiments. Mar: Westinghouse completes "Final" Safety Analysis Report. SNL releases FER screening and analysis four scenarios (ED, E1, E2, E1E2). Dec: SNL issues final full PA highlighting use of CAMCON modeling system (e.g. secondary parameter database completed). Coupling of code demonstrated, which allowed better evaluation such as sensitivity analysis. PA includes both scenarios and parameter uncertainty: out of three parameters, solubility, intrusion time, and borehole permeability important; cuttings from direct drilling important release pathway.</p> | <p>★ 1990 - Jan: DOE issues Final Supplemental EIS. DOE issues "Record of Decision" on WIPP Final Supplemental EIS stating construction is officially complete. Testing phase (~5 yr) should proceed, and then another Supplemental EIS should be prepared before going to full operation.</p> | <p>● 1990 - Oct: EPA issues no migration variance for test phase of WIPP.</p>  | <p>Canruthers Administration</p> <p>● 1990 - Jul: NM granted authority by EPA to regulate radioactive mixed waste, and thus WIPP waste becomes subject to NM regulations. NM Environmental Improvement Division requests submittal of Parts A and B of RCRA permit. Oct: NM designates "preferred route" for waste transport from northern border to WIPP.</p> |
| 1991      | <p>1991 Major models linked in WIPP PA</p>    | <p>★ 1991 - Westinghouse completes Parts A and B of RCRA permit application. Apr &amp; Aug: To extend life of room 1, panel 1 for gas generation tests, internal and external ponds most and recommend roof support. Sept: Westinghouse completes construction of roof support. Dec: SNL issues second PA highlighting major components of the PA process and documents (e.g., rigorous use of scenarios and geostatistics for transmissivity fields); 46 parameters sampled; cuttings most important release pathway.</p>   | <p>● 1991 - In response to audit, AL manager creates WIPP Project Integration Office (WPIO) in Albuquerque over WFO in Carlsbad.</p>   | <p>● 1991 - Jan: DOI modifies administrative land withdrawal order to allow test phase of WIPP. Mar: House Interior Committee adopts NM Congressman Richardson's resolution to nullify DOI modified land withdrawal order (action allowed under Federal Land Policy and Management Act (FLPMA)). Sept: 9th Circuit Court of Appeals rules state ban on radioactive waste shipments imposed by Gov. Andrew of Idaho is illegal. Oct: DOI again grants administrative land withdrawal after Watkins certifies all environmental permitting requirements have been met.</p> | <p>King Administration</p> <p>● 1991 - AG: Utah. Oct: AG Utah files 1000-page lawsuit in U.S. District Court for the District of Columbia to delay start of test phase at WIPP by challenging the administrative land withdrawal.</p>  |



| 1992 | 1992 Refinements to models (e.g., transmissivity) tested in WIPP PA | ★ 1992 - SNL and Westinghouse complete work necessary to modify Test Phase Plan for gas generation tests. Westinghouse completes work necessary for modifying Waste Removal Plan. June: NAE WIPP Panel sends letter to DOE questioning scientific need for in situ waste tests at WIPP. Dec: SNL issues third PA testing models and data used in the PA, uncertainty in transmissivity fields refined, 48 parameters sampled, evaluated time-dependent, a parameter in Poisson intrusion model, direct outflow most important pathway. | ● 1992 - Aug: DOE submits application to New Mexico Environment Department (NMED) for RCRA permit for test phase.  | ★ 1992 - Oct: WIPP Land Withdrawal Act (LWA):<br>- transfers land from DOI to DOE<br>- establishes EPA as regulator for WIPP (removing self-regulation by DOE); compliance requirements (different from WIPP Panel or EEO) to be set in 40 CFR 194<br>- requires recertifying site every 5 yr<br>- revisits Subpart B of 40 CFR 191, except disputed aspects of individual and groundwater protection requirements<br>- requires DOE cooperation and consultation with EEO<br>- NM given \$600 million over 30 yr<br>Energy Policy Act:<br>- asks NAE to recommend disposal criteria for Yucca Mt.<br>- requires EPA and NRC to reevaluate their disposal criteria for Yucca Mt.<br>Federal Facility Compliance Act:<br>- waives federal sovereign immunity for civil and criminal liability for RCRA violations and thus brings DOE facilities under jurisdiction of 3000s but exempts mixed waste stored by DOE<br>Washington DC District Court Judge Piers grants preliminary injunction to stop testing with TRU waste at WIPP. Piers rules WIPP does not qualify for interim status under RCRA. Thus must get permits before rather than during operation. | ● 1992 - Environmental Defense Fund (EDF) and NMED join the NM lawsuit and seek to make RCRA issues more important (e.g., interim status of WIPP).    |
|------|---|--|--|---|---|
| 1993 | 1993 DOE decides not to test waste at WIPP                          | ● 1993 - Time inflow to Q tunnel can be explored as either dewatering of disturbed rock zone or Darcy flow through soil.   | ★ 1993 - DOE Sec: Hazel O'Leary. Oct: DOE concurs with NAE and decides not to employ waste in a pilot phase at WIPP - lab tests instead. DOE decides to make draft Compliance Certification Application (CCA) to EPA. Because actual waste not coming to WIPP, "San tests" cancelled. Dec: O'Leary demands WPPQ in Albuquerque and selects new personnel for Carlsbad Area Office (CAO) (old WPPQ with new functions) and direct reporting to Undersecretary T. Grunsky. | ★ 1993 - Feb: EPA announces intent to promulgate 40 CFR 194 to specify requirements for implementing 40 CFR 191 at WIPP. Dec: In response to court demand and WIPP LWA, EPA reorganizes 40 CFR 191 to address individual and groundwater protection requirements, and makes other changes - no influential changes for WIPP.  | ● 1993 - Mayor Forrest of Carlsbad demands more economic benefits accrue to city of Carlsbad from WIPP. NMED issues Draft RCRA permit for test phase. |
| 1994 |   | ● 1994 - Mar: SNL explores possibility of linking PA with decision analysis in System Prioritization Methodology (SPM); results form basis of Draft Compliance Certification Application (DCCA). Aug: SNL seeks permits to drill new wells for tracer test in Culberr.   | ● 1994 - Mar: DOE submits DCCA to EPA for review. May: DOE submits Part B of RCRA permit application to NMED. Oct: DOE halts all in situ experiments and closes area in repository.  | ● 1994 - Congress authorizes funding for EEO for additional 5 yr.   |   |
| 1995 | 1995 Tracer test begins in Culberr                                  | ★ 1995 - Feb: Drilling of wells for tracer tests begins. Sep: Gas generation studies completed and results used to establish rates for CCA. Oct: IT Corp. completes cost/benefit study for Westinghouse and DOE of engineered barrier alternatives required by 40 CFR 194. Dec: DOE publishes updated revision of WIPP Inventory. Computer specialists hired to modify CAMCOON implementation to enhance software configuration management and control runs for PA calculations. Second attempt at SPM.                                | ● 1995 - Mar: DOE provides guidance on new regulation for potential Yucca Mt. repository; suggests reporting risk from human intrusion separately. Jan: EPA processes compliance criteria for WIPP in 40 CFR 194. May: DOE comments that 40 CFR 194 exceeds scope of 40 CFR 191. Oct: EPA issues draft of non-binding Compliance Application Guide (CAG).  | ● 1995 - NAE provides guidance on new regulation for potential Yucca Mt. repository; suggests reporting risk from human intrusion separately. Jan: EPA processes compliance criteria for WIPP in 40 CFR 194. May: DOE comments that 40 CFR 194 exceeds scope of 40 CFR 191. Oct: EPA issues draft of non-binding Compliance Application Guide (CAG).  |   |

| Time Line | Noteworthy Events   | Technical Milestones Related to the WIPP   | U.S. President and DOE: Directives and Decisions  | Federal Legislation, Judicial Decisions, and Regulatory Requirements Related to Nuclear Waste Disposal  | New Mexico Administration, Regional Issues, and Legal Challenges   |
|-----------|---|--|---|---|--|
| 1996      | <p>1996 EPA starts how to implement radioactive waste standard in 40 CFR 194.</p>  <p>1996 SNL completes PA for WIPP certification; moving van required to send 50046 to EPA.</p>  <p>1996 Tests on solubility reported.</p>  <p>1996 SNL concludes dual porosity model explains transport in Cuddeback.</p>    | <p>★ 1996 - Apr: SNL completes tracer test in Cuddeback, decides dual-porosity model reasonable and single-porosity transport alternative model could be ruled out. <b>Jul:</b> SNL reports on early results of retardation batch experiments. Tests on solubility reported for use by CCA. <b>Oct:</b> SNL completes PA for CCA of WIPP that includes Mgo backfill except for low vectors, drill cuttings only reliable pathway; 57 parameters sampled. Calculation run three times with 100 samples each, takes 37,000 CPU hrs on 40 DEC alpha processors, and retains 100 GB of data in 97,000 files. <b>Nov:</b> NAE reports that WIPP site "excellent choice" geologically.</p> | <p>★ 1996 - Oct: DOE sends 80,000-page, 450-lb. CCA to EPA. <b>Nov:</b> DOE issues 80,000-page second Supplemental Draft EIS.</p>   | <p>★ 1996 - Feb: EPA promulgates final 40 CFR 194, directs DOE to consider additional criteria in assessing system performance:</p> <ul style="list-style-type: none"><li>- requires waste characterization analysis and engineered barrier evaluation</li><li>- requires a monitoring system</li><li>- specifies requirements on quality assurance (QA), peer review, and expert judgment</li><li>- requires peer review on waste characterization, engineered and natural barriers, and conceptual models</li><li>- expands human activities (e.g., potash mining) to consider in performance assessment</li></ul> <p><b>Sept:</b> Congress amends WIPP LWA and relieves WIPP of need to comply with land disposal restrictions of RCRA, but other requirements of RCRA still apply. <b>Dec:</b> EPA begins detailed evaluation of CCA and supporting information at SNL and elsewhere, including SNL PA conceptual models, computer codes, model parameters, QA records, and specific technical issues (e.g., Mgo backfill and passive institutional control).</p> | <p>● 1996 - Apr: NM AG Usual asks EPA alleging improper meetings were held between EPA and DOE about requirements in proposed 40 CFR 194 regulation.</p> |
| 1997      | <p>● 1997 - June: Conceptual Model Peer Review Group (formed in response to 40 CFR 194) concludes 22 of 24 conceptual models adequate. Spallings model must be redone and Mgo backfill description improved. <b>Mar:</b> SNL conducts mini-PA for EPA to do parametric sensitivity analysis of PA model parameters lacking "iron-clad" defense. <b>Apr:</b> Conceptual Model Peer Review Group reports that with additional information provided by SNL, they are satisfied that the new model of sealings and the model of the Mgo backfill are adequate. <b>May:</b> SNL explains apparent discrepancy between geohydrology and geochemistry by viewing flow in Cuddeback as a 3D regional system. As part of EPA evaluation of CCA, SNL runs EPA-mandated PA calculations using EPA-selected values for 26 parameters and EPA-selected model assumptions, based on results from parameter review team comments in Dec 96 and sensitivity analysis in Mar 97.</p> | <p>● 1997 - DOE Secretary, <b>Feb:</b> DOE holds hearings on second Supplemental Draft EIS for WIPP in Carlsbad, Albuquerque, and Santa Fe, New Mexico. <b>Sept:</b> Final second Supplemental EIS on WIPP published.</p>  | <p>● 1997 - May: In letter to DOE secretary, EPA Administrator Browner directs DOE application "complete"; this starts the 1-yr clock for review of CCA. <b>June:</b> Appeals Court in Washington rules meetings between EPA and DOE proper when one agency proposes regulations for another agency as required by Executive Order and says NM and TX lawsuit is without basis. <b>Oct:</b> EPA issues draft rule to approve WIPP with conditions; requires use of panel seals used in PA; design requires QA for waste generations; lists requirements for using process knowledge to characterize wastes; requires schedule for installing passive controls; denies any protective credit for passive controls; and 120-day public comment period begins.</p> | <p>Johnson Administration</p>   |  |

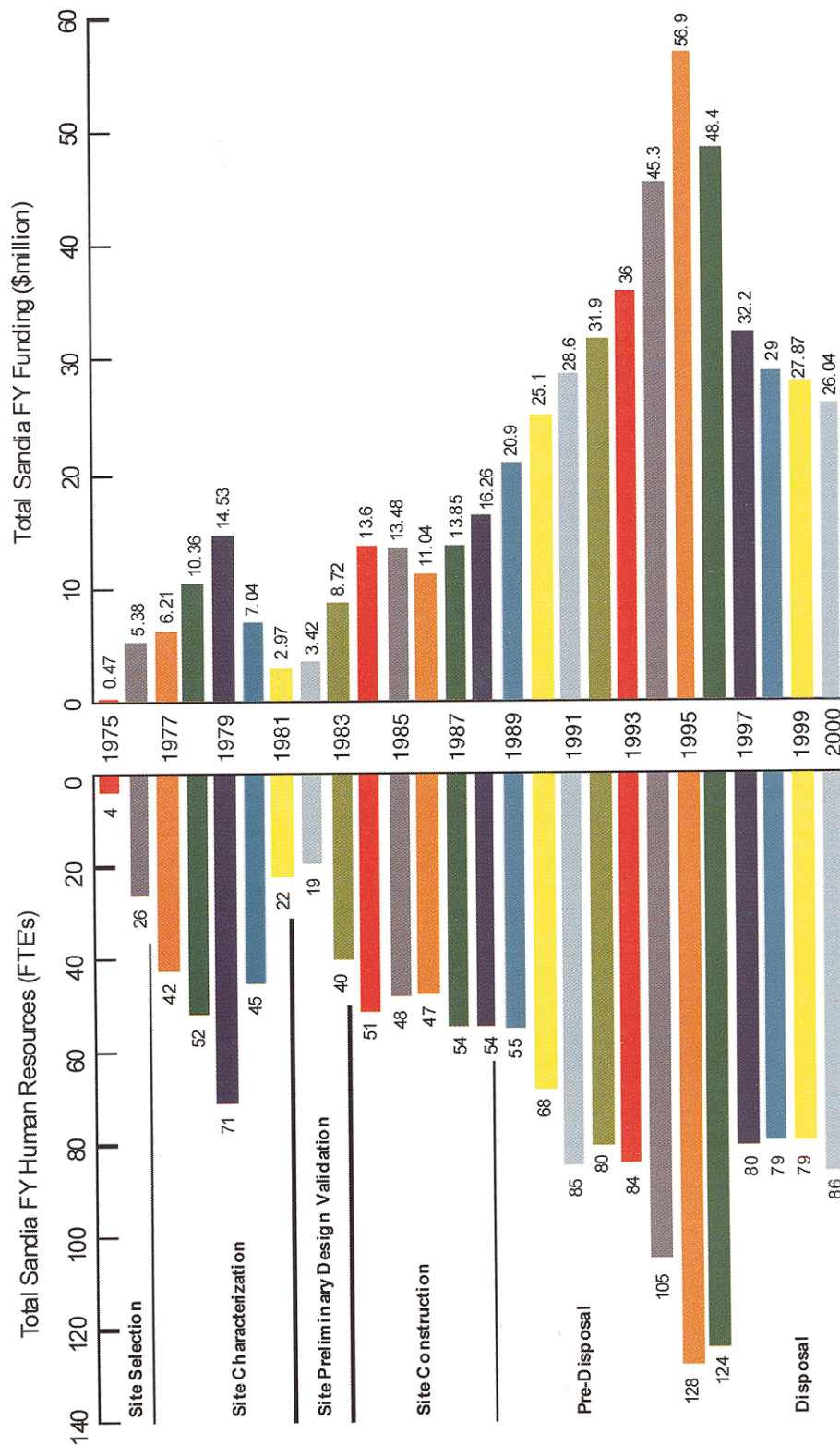
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|------|--|--|---|---|--|
| 1998 | <br>1998 EPA certifies WIPP | <ul style="list-style-type: none"> <li>● 1999 - Mar: First shipment of non-RCRA waste arrives at WIPP from Los Alamos. Apr: First shipment of non-RCRA waste arrives at WIPP from INEL. June: First shipment of non-RCRA waste arrives at WIPP from Rocky Flats. Decay products of naturally occurring uranium-238 (radium-226 and radon-222), discovered on swipe test on outside of Rocky Flats container: this discovery caused stir in the media.</li> </ul> | <ul style="list-style-type: none"> <li>● 1998 - Jan: DOE publishes record of decision to proceed with opening WIPP based on second Supplemental EIS. July: DOE Secretary Richardson (former NM Congressman).</li> </ul> | <ul style="list-style-type: none"> <li>★ 1998 - May: EPA certifies WIPP.</li> <li>● 1999 - Mar: Judge Porel lifts injunction placed on WIPP in 1992; also reverses decision and states WIPP does qualify for interim status under RCRA. June: Court of Appeals, District of Columbia, dismisses (without hearing oral arguments) CAND and SWINOC petition to overturn EPA certification.</li> </ul> | <p>Johnson Administration</p> <ul style="list-style-type: none"> <li>● 1998 - Jul: NM AG Usell sues EPA, alleging insufficient time to comment on CCA, CAND and SWINOC also file lawsuits.</li> <li>● 1999 - Feb &amp; Mar: NMED holds hearings in Santa Fe on RCRA permit for WIPP. Apr: AG NM Maschke withdraws from lawsuit challenging EPA certification.</li> </ul> |
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# APPENDIX B

## Funding History of the WIPP Project

Sandia National Laboratories WIPP Project Resource History





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DE-AC04-94AL85000.



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